UNIVERSITY OF MICHIGAN
AUG 10 1954
FORESTRY LIBRARY

WORLD CROPS

embracing

AGRONOMY, HANDLING, PROCESSING, STORAGE AND PROTECTION
SOILS, CHEMICALS, IRRIGATION, ENGINEERING AND ECONOMICS

A Silorator Hayter Harvester harvesting and silorating lucerne at Brentwood, New Zealand

VOLUME 6, No. 8 AUGUST 1954

A Publication of The Leonard Hill Technical Group

Water-Hyacinth DESTROYED!

...by MONSANTO'S 2:4-D

Monsanto's 2:4-D Sodium Salt has proved invaluable in freeing reservoirs, irrigation and transport canals from water hyacinth. Throughout the tropics, and in the southern U.S.A., this thoroughly effective, yet economical chemical has saved hours of expensive hand labour — keeping vital waterways clear of this prolific weed.

MONSANTO

In association with: Monsanto Chemical Company, St. Louis, U.S.A., Monsanto Canada Ltd., Montreal, Monsanto Chemicals (Australia) Ltd., Melbourne, Monsanto Chemicals of India Ltd., Bombay.

Pentachlorophenol

In irrigation canals, especially on sugar plantations, another aquatic weed-killer — Monsanto's Pentachlorophenol 25% Emulsifiable Concentrate — has been outstandingly successful in controlling the growth of submerged and floating weeds not destroyed by 2:4-D. *Write for full details.*

MONSANTO CHEMICALS LIMITED,
Victoria Station House,
Victoria Street, London, S.W.1.

WORLD CROPS

Editor: Sir Harold A. Tempany, C.M.G., C.B.E., D.SC., F.R.I.C.

Vol. 6. No. 8 — AUGUST 1954

CONTENTS

EDITORIAL COMMENT:

Natural versus Synthetic Rubber; The Fruits of Research; The Dust Bowl, 1954; Wheat Supplies and Prices; Flood Protection and Land Reclamation in Holland; Making Known; Counting World Crops; BHC and Sorghum Seed; The Recent Cotton Congress 307

Possible Applications of Photoperiodism in Plants—*R. H. Stoughton*, D.SC., *and Daphne Vince*, PH.D. 311

The Tea Industry in Indonesia—*G. C. Denham*, C.M.G., C.I.E. 314

Recent Research on Arabian Coffee—*A. E. Haarer*, F.L.S., DIP.HORT.R.H.S. 317

Contrasts and Comparisons—*A. C. Barnes*, C.M.G., B.SC., F.R.I.C. 321

The Cocoa Industry in Nigeria, The British Cameroons and The French Cameroons—Part 2, The British Cameroons—*D. H. Urquhart*, B.SC., *and G. A. Ross Wood*, B.SC. 325

Australian Farming News 329

The Toxicity Hazard of Aldrin, Dieldrin and other Chlorinated Hydrocarbon Insecticides—*Frank Princi*, M.D., F.A.C.P. 330

The Mechanical Clearing of Forest and Scrub Land 333

Mechanisation in Cotton Growing—*W. T. Winterbottom*, C.B.E., *and Dr. C. B. Sayre* 337

The Royal Show 341

Open Day at the National Institute of Agricultural Engineering 345

New Books 346

Reports and Publications 347

World Crop Reports 349

Published monthly by Leonard Hill Limited, Stratford House, 9 Eden Street, London, N.W.1, England (Tel. Euston 5911)

Subscription rates: *1 year 8 dollars, 3 years 20 dollars, paid in advance*

DRON-WAL *Supreme and* SPRAYERS SYRINGES

KNAPSACK SPRAYERS

No. 1 (Pat. No. 626777) with patent cam action pump, easy to operate diaphragm pump, less working parts than any other and less spare parts required.

Catalogues and full particulars of all the lines we make on request.

No. 8 'Easi-Fill' Pneumatic Sprayer. All brass container, strongly made with Trigger Release, Brass Lance and very fine spray Nozzle, with shoulder strap for carrying. In 1½, 2½ and 3½ gallon working capacity sizes.

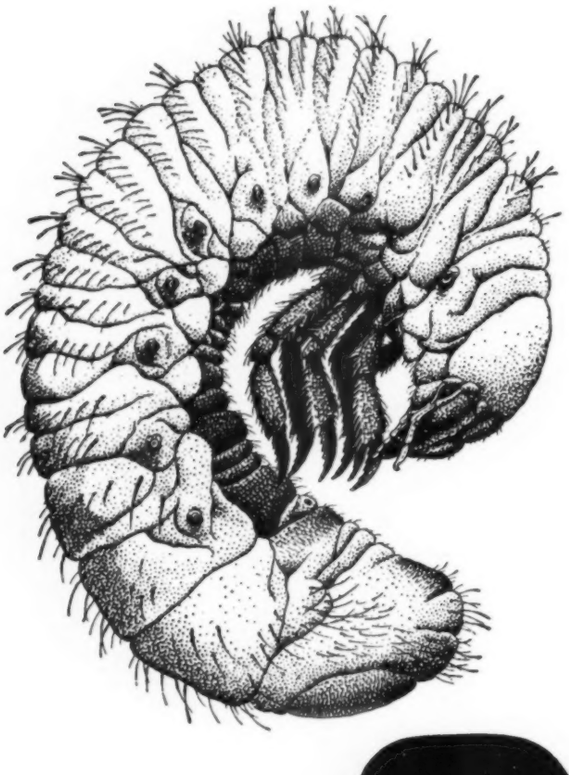
The PHILIP B. WALDRON CO., Kings Road, Tyseley, BIRMINGHAM 11

The photograph on our front cover shows the 'Gold Medal' Silorator Hayter Harvester cutting, lacerating and loading silage on a New Zealand farm

Tests have proved that silage made the 'Silorator way' has a much higher protein content than silage which is not pre-treated. By lacerating the crop, the Silorator destroys the breathing mechanisms, bruises out the sap and enables fermentation to start at once—so that there is scarcely any loss of food value.

Silage making, however, is only one of the jobs this implement can do. It can pick up, break and scatter combine straw; cut, crush and spread green manures, pull roots, process compost, aerate grain and do many similar jobs. A versatile implement—and no mistake!

White Grub (*Phyllophaga and Melolontha spp.*)



NEW fighting weapons for agriculture

The majority of agricultural pests are doomed, now that two new Shell insecticides, *aldrin* and *dieldrin*, have entered the battle to grow more food.

Of these new pest destroyers, *aldrin* is the one to use against white grubs. Dust *aldrin* over the soil before sowing cereals, root crops including potatoes, or grasses; or spray the soil with *aldrin* during cultivation.

In the soil *aldrin* retains its insecticidal potency for long periods: it will not taint a crop: it is alkali-stable.

aldrin

dieldrin

FULL INFORMATION
FROM YOUR LOCAL
SHELL COMPANY

are SHELL insecticides

Editorial Comment

Natural versus synthetic rubber

IN an interesting editorial in the *Planters' Bulletin* of the Rubber Research Institute of Malaya, the question was recently posed whether research can rescue natural rubber from the threatened position which it at present occupies owing to the ever increasing competition of the synthetic rubber substitutes. The writer of the article points out that during the past five years there has been a steady decline in the consumption of natural rubber in the U.S.A. and a corresponding increase in the consumption of synthetics, and expresses doubts whether the gravity of the situation is as yet sufficiently appreciated by rubber growers in Malaya and, one might add, in other parts of the tropics where rubber is a major item of agricultural production.

The production of synthetic rubber substitutes as a major industrial operation, in the U.S.A. at any rate, began as a direct consequence of the last war when supplies of natural rubber from the East were suddenly cut off as a result of the invasion of Malaya and Indonesia by the Japanese. Their rapid development was made possible as a result of intensive research on a large scale, but when the place of the main synthetic product known as GR-S had become well established, research was not curtailed or suspended; on the contrary it still continues and of later years has had for its object the improvement of the quality of synthetic rubbers and the development of materials for specific purposes. Thus we have had oil resistant products like the thiokols or heat resistant materials like the silicones. A very recent development is based upon two series of synthetic copolymers, one using isocyanates and the other epoxy compounds, which have led to the production of materials which appear to be of superlative excellence. It has been stated for instance that tyre treads made from one of these can outlast the entire life of the average car. These new products are at present admittedly expensive, they are in short supply and they are difficult to produce, but judging by results in other fields this state of affairs may be expected to rectify itself in the next few years, when it may well happen that ample supplies will become available. On this account the outlook for the natural rubber industry is considered to be by no means rosy. The fear seems to be not so much that natural rubber will disappear from the market as that the natural material may come to play a Cinderella-like role and manufacturers will only use it because they cannot get enough of the synthetic products at the prices they desire to pay.

The fruits of research

THE present position of the synthetic rubber industry has, in fact, been achieved solely through research, and it is well to remember that what research has achieved for synthetic substitutes it is well within the bounds of possibility for it to achieve for natural rubber, provided expenditure on a commensurate scale is envisaged. The rubber industry in the Far East is generally regarded as being among the most enlightened of tropical industries in this regard, but the expenditure incurred or envisaged on synthetics research in the U.S.A. is on a scale which far transcends that spent on rubber research in Malaya or the United Kingdom. For example, in 1952 the expenditure on research on synthetics in the U.S.A. was approximately equivalent to $7 million gold, while the total expenditure in Malaya and the United Kingdom was less than $1 million gold. It is true that to this must be added the expenditure on research in Ceylon, Indonesia and elsewhere, but this is far smaller than that in Malaya and the total amount must be considerably less than the U.S.A. expenditure. In October 1953 the *India Rubber World* quoted an American authority as stating that he estimates that the total expenditure of the synthetic rubber industry on research in the next few years will lie between $13 and $15 million gold.

The funds available for expenditure on rubber research in Malaya are derived from a cess which goes to a fund called the Malayan Rubber Fund administered by a board appointed with the approval of the Malayan Government. Recently the price of rubber has slumped badly and a demand has arisen from the board that expenditure on research should be curtailed. This is in line with what occurred in the past, for example in 1932 the price of rubber fell to very low values and a demand arose for the curtailment of research activities in order to reduce expenditure. As a result the research services were severely curtailed, a blow from which they had hardly recovered when the last war broke out.

It is sincerely to be hoped that the authorities of the Malayan Rubber Fund will appreciate that the main hope for the survival and future prosperity of the natural rubber industry lies not in making economies in the research expenditure but in enabling the natural rubber industry to expand its research until it is able to compete on more or less equal terms with its synthetic rival.

The question naturally poses itself, what can the natural rubber industry expect from research in the way of a solution of its present problems and difficulties? Obviously there is no simple answer to this, but it seems by no means beyond the bounds of possibility to devise techniques whereby natural rubber may be modified to produce an outstandingly superior product which will compete with the synthetic materials. This involves research not only on the chemical and physical properties of rubber and rubber latex in the laboratory and the factory, but also on the production of rubber in the field by the tree. Work on these lines is already in progress or in prospect. To assist in and to ensure that the research workers receive the best possible guidance and advice on the scientific side the authorities of the Rubber Research Institutes of Malaya and Ceylon have lately set up in the United Kingdom a scientific advisory committee which includes leading authorities on the different branches of research involved.

Obviously curtailment of research activity as an economy measure cannot be expected to produce a solution of the problems; indeed it is hardly too much to say that such a proceeding would probably be almost the equivalent of sealing the death warrant of the natural rubber industry.

The dust bowl. 1954

IT was somewhat depressing to learn from a Washington report in a recent issue of the *Journal of Agricultural and Food Chemistry* (**2**, 498, 1954) that ' the present 17 million-acre dust bowl covers a wider area than did its famous predecessor of 20 years ago . . .' and that ' a new generation of " Okies " may be forced to pack up and leave the dusty, drought-ridden Great Plains.' New Government aid is being allocated to State and local agencies, certainly up to the sum of $10 million and probably up to $15 million. The USDA's Soil Conservation Service has announced a revised programme of both immediate and long-term aid for the affected area. This is news that shakes complacency. Soil scientists and agronomists, particularly those who work in other countries, have been optimistically assuming that technical measures had not only stemmed the expansive force of erosion but were beginning to reclaim some of the dust-bowl acreage. Drier weather since 1950, culminating now in the 1954 drought, described as the fourth major drought since 1880, has seemingly shattered much of the progress made. Also favourable weather for several years before 1950 encouraged a new burst of ploughing and cash cropping. From 1939 to 1949 the wheat acreage in the area rose by 6½ million acres. The old epigram—the one thing that man learns from history is that he never does—seems at least particularly applicable.

In five States—Kansas, Colorado, Texas, New Mexico and Oklahoma—it is estimated that another 14 to 15 million acres of land is *liable* to be added to the 17 million acres already classified as lost or damaged. It is a liability that will turn into hard fact unless plentiful rainfall or soil conservation measures can restore the situation. The former hope is solely a matter of chance for even the most enthusiastic supporter of artificial rain-making could hardly credit cloud-seeding with the moisture-producing capacity required. Bare soil must be speedily given a protective cover of vegetation, either by cover crops deliberately grown or by encouraging natural weed development; penalties may have to be applied to prevent further cash-cropping on poor soils. An intensive campaign for suitable land use, fortified by subsidies to relieve immediate losses, must be urgently introduced. Even so, it remains to be seen whether the time-factor can be overcome.

Wheat supplies and prices

THE sudden break in wheat prices which occurred over the week-end at Whitsuntide has caused widespread concern in some major wheat-producing countries. As a result wheat importers in Britain were able to buy Canadian and American wheat 30s. per ton cheaper than in the previous week. The drop in price followed, within a matter of hours, the Canadian Wheat Board's cut of approximately 9d. per bushel which followed a slightly smaller reduction by American exporters.

The fall in price is the result of record crops and growing surpluses. Readers may recollect that the position in this regard formed the subject of a comment in these columns in our issue for March last; since then stocks have continued to accumulate. Last July the stocks in the four major exporting countries, the U.S.A., Canada, Argentina, and Australia, reached the record peace-time figure of 1,200 million bushels, while the indications are that by the end of July 1954 they are likely to have expanded to 1,650 million bushels, which is nearly three times the volume of this year's total exports from these four countries. It seems, moreover, that despite the fall in price it is little likely to be followed by any marked increase in world consumption since, *inter alia*, it appears that the world's rice crop will be extremely good this year which will prejudice the chances of selling more wheat in the countries of the Far East to make up for rice shortages.

There seems to be some disposition in some wheat-exporting countries to blame Great Britain for declining to sign the new international wheat agreement when it was renewed last year. It will be remembered that at that time, despite the growing burden of accumulating wheat surpluses, the exporting countries led by the United States insisted that the maximum export price should be raised steeply to $2.05 gold per bushel. At the time Britain was prepared to concede $2.00 which events have shown was more than the position justified. The suggestion, made in some quarters, that the present price of wheat is low because of production subsidies in some countries and that, in consequence, the price is bound to rise again in the future is, as the London *Times* points out, certainly not justified.

These developments in fact provide no grounds for modifying the opinion expressed in our issue for March last, that efforts to bolster up the international price of a commodity in the face of very large world stocks over a long period by means of international agreements have little real hope of success. The utmost that can be hoped from them is that they may facilitate the reduction of stocks during such time as world production is being adjusted to world consuming capacity.

Flood protection and land reclamation in Holland

WE are informed that a vast civil engineering project, involving the sealing off of four of the five sea estuaries in South West Holland, has recently been recommended by a committee of experts set up to advise the Dutch Government on the efficient future protection of the area affected by the floods in 1953. In considering the problem the question arose as to whether it would be possible to broaden and elevate the existing sea dykes in this area, which are hundreds of miles long, or whether the four large sea estuaries should be closed with short but heavy dykes.

In its recently published report the committee not only declared the closure of the estuaries to be technically possible, but considered that the advantages of doing so would be so great that it unanimously advised the construction of the four enclosing dams. If the recommendations of the committee are endorsed by the Government and the necessary bill passes through the Dutch Parliament the work can be started soon afterwards.

The project would take about 25 years to complete and would cost from fls. 1,500,000,000 to fls. 2,000,000,000. The enclosing dams would total about 20 km. (12½ miles) in length and the dykes would be projected through the estuaries which, here and there, are 40 metres (130 ft.) deep and have a difference of 4½ metres (14½ ft.) between high and low water level. The construction of the dams would involve technical problems more difficult than those encountered in the construction of the Zuider Zee dam. Auto roads would be built on the dykes, behind which a fresh-water reservoir would eventually be made. In the mouths of the rivers Rhine and Meuse the borderline between fresh and salt water would recede many miles and the threat of an excessive salt content of the soil in the heart of the Province of South Holland would be permanently removed.

A separate scheme, known as the ' Three Islands Plan,' is also being studied by the Dutch Government Technical Service for constructing two dams between the islands of Walcheren, South Beveland and North Beveland for land reclamation. The Walcheren-North Beveland dam would be the first of the four dams recommended by the ' Delta ' Committee. The genius of the Dutch for land drainage and reclamation is a by-word, and if this great scheme materialises and is carried into effect it will be one more instance of the skill and resource which they have been able to bring to the solution of the problems of reclamation on which the welfare and even the existence of the Dutch community are so largely dependent.

Making known

THE suggestion that more papers reporting original research might be published in the technical press was made by Mr. W. Leonard Hill, Chairman of the Agriculture Group of the Society of Chemical Industry, at the Annual General Meeting held in Burlington House, London, in May last. Mr. Hill, who is better known as a publisher, being head of the firm of Leonard Hill Limited, publishers of WORLD CROPS and 12 other technical periodicals, was speaking of the function of the private publisher in the process of disseminating useful knowledge.

He called his address ' Making Known,' and he opened by referring to a recent letter in *Nature* criticising the failure of the Colonial Products Research Council to publish results of publicly-financed work on insecticidal sprays. Undoubtedly much useful technical information is being permanently lost because of the reluctance of the people concerned to write up their work for publication. Some industries are excessively secretive in contrast to the much freer exchange of technological information in the United States.

In contrast to the paucity of technological information there is no lack of research papers emanating from more academic organisations. The difficulty here is to get all these papers published. It was at this point that Mr. Hill suggested that the technical press might be willing to publish more research papers. If such papers were accompanied by editorial summaries pointing out their significance in less technical language, they would probably interest technologists and business men and the application of pure knowledge would be accelerated.

Another point raised by Mr. Hill was the remuneration of authors. Unlike the journals of pure science, technical journals almost invariably paid their contributors. Occasionally these payments are contrasted unfavourably with those made by the big newspapers and national magazines but this, it was suggested, is an unfair comparison bearing in mind the obvious financial differences between the popular and the technical press.

The greater part of Mr. Hill's address was taken up by a detailed account of the work of the various partners in the business of technical book publishing—the author, publisher, printer, binder, paper maker and bookseller. Their relationships with each other were described in fascinating detail based on an experience of over 30 years in publishing. The preparation of manuscripts, selection of publisher, proofs, copyright—British and American—reviews and the selling of technical books were all discussed. The importance of reviews was underlined by Mr. Hill who pointed out, to the surprise of many of his audience, that there is literature on reviewing. Another point emphasised was the importance of the technical bookseller who works for comparatively small returns and whose role in the process of disseminating technical and scientific knowledge is not always properly appreciated.

Counting world crops

WE are informed by the authorities of FAO that about the end of this year they expect to issue the first of a series of three volumes which will embody the results of the 1950 World Census of Agriculture. Publication of two further volumes in 1955 and 1956 will bring to an end almost ten years of preparation and of analysis and collation of facts gained from about 100 countries and territories.

We are further informed that the census figures will show the number of farms, classified as to size, in all the reporting countries and how many are farmed by owners, tenants or under other systems of tenure. They will also show total areas under various crops and the number of livestock and what proportions of the various types of stock and crops are found in the various sizes of farms. They will give totals for employed farm labour and show how the labour is divided between farms of various sizes and will also show the degree of mechanisation on the farms of various sizes in the reporting countries.

The census is intended to give an overall inventory of the world's agricultural resources. Preparations for the census began in 1947, subsequently international and regional training centres were held by FAO in Mexico, Baghdad, Paris, Cairo, New Delhi and Calcutta for the officials who were to carry out the census in their own countries. After the census a training course on tabulation of census results was held in Rio de Janeiro in 1951. The first volume of the census report will describe the statistical methods used in carrying out the census. The second volume will present country-by-country figures in a systematic tabulation on a uniform basis. The third volume will compare the figures

of individual countries and analyse important features of agricultural structure.

This is only the third world census of agriculture ever attempted but agricultural censuses on a national and provincial scale have been taken almost since governments expanded beyond tribal boundaries.

In the past half century they have become of enormous importance to governments in assessing national assets and to commence in predicting price movements. Production and trade figures can reveal declines in production which, if unchecked, can lead to famine-scale scarcities or to increases which can lead to economically-disastrous gluts. In these days of rapid transport and increased world trade they are the essential basis of international trades and agricultural planning.

Today FAO carries a major responsibility for collecting, collating and publishing a continuous record of world production and trade in agricultural commodities. This is compiled from official statistical publications by the individual countries and from answers to questionnaires sent out to more than 150 countries and territories at regular intervals throughout the year. To the authorities of FAO a considerable debt of gratitude is due for carrying out these services on a world-wide basis and for bringing to a successful conclusion a herculean task which eclipses in magnitude the previous world censuses undertaken by the former International Institute of Agriculture.

BHC and sorghum seed

IN the Sudan the young roots of sorghum seedlings are extremely vulnerable to attack by cockchafer grubs. Once well established the plants withstand these attacks fairly well but the early damage causes severe losses, both by loss of plants and by reduced yields from the surviving plants whose development suffers checks from wilting and stunting. Experiments recently reported from the Gezira Research Farm at Wad Medani (*Nature*, **173**, 1052, 1954) indicate that seed dressing is a simple and relatively inexpensive remedy. The chemical answer is gamma-benzene-hexachloride (BHC) which once again reveals its versatile potency as a soil insecticide. The amount of BHC needed to give effective protection per acre seems incredibly minute—only 2 g. per acre; but the dressing itself, containing 20% of BHC, is given to the seed at a rate of only 1 g. per lb., and the seed rate is about 10 lb. per acre. It is uncertain whether the insecticide kills many grubs; living grubs were found in the soil near seeds and seedlings so that it is a more likely assumption that at this low rate of use BHC acts predominantly as a repellent. Stands from treated seed were of the 90% to 100% standard compared with a 50% to 60% standard for untreated seed. Increasing the rate of dressing to secure a kill rather than a local repulsion of grubs might appear to be attractive, but there is evidence that phytotoxic problems are introduced if the BHC rate is doubled, even though this means no more than a rate of 4 g. per acre. In any case temporary protection by repulsion is adequate defence for once the plants are reasonably established the grubs cease to be a serious economic menace.

In other parts of the world where soil-inhabiting grubs make the establishment of grass family crops difficult, gamma-BHC as a seed dressing obviously deserves consideration and testing. However, crops that develop deep and vital taproots, *e.g.* groundnuts and beans, have not been as effectively protected in similar experiments in the Sudan. The taproot is much more susceptible to grub attack and critical harm can be done to the plant long after the first month of growth; by that time, of course, the root has extended itself out of the seed-zone where the insecticide dressing can exercise its repelling effects.

The recent cotton congress

THE Jubilee Congress of the International Federation of Master Cotton Spinners' and Manufacturers' Associations was held in Buxton, Derbyshire, from May 13 to 26; it was attended by about 250 delegates from many parts of the world.

The theme of the congress was 'The Cotton Industry Today and Tomorrow' and papers were read on every aspect of the industry. Of particular interest to readers of WORLD CROPS was a paper by the congress president, Mr. W. T. Winterbottom (England), in conjunction with Dr. Charles R. Sayre (U.S.A.), entitled 'Mechanisation in Cotton Growing,' which we reproduce in shortened form on another page. In this a general survey of the world position made, with particular reference to the United States. It was concluded that mechanisation of cotton growing is likely to be a slow development in all cotton growing areas, with the exception of the U.S.A.

The director of The Giza Spinning Test Mill, A. A. Youseff, and the chief of the research and testing laboratory of the mill, A. M. Abdel Hafez, presented a paper surveying Egyptian cotton, with special reference to the new types recently developed by the Ministry of Agriculture. The Egyptian Government's policy in this respect for the near future is the maintenance of the present commercial seed strains and the limited propagation of some of the new types which have similar characteristics to the present varieties. These new varieties will act as a reserve in case of necessity.

An excellent survey, 'Cotton Outside the United States and Egypt,' was given by E. Lord of the British Cotton Industry Research Association (Shirley Institute), Manchester. World War II caused startling changes in many cotton-growing areas and this paper presented an up-to-date picture of the cotton growing position among the larger producers, together with reference to small crops of particular interest.

It was decided during the congress that the International Federation of Master Cotton Spinners' and Manufacturers' Associations would change its name from September 1 next. Its new title will be the International Federation of Cotton and Allied Textile Industries. The purpose of this change is to extend the scope of the federation's work to include the newer man-made and synthetic fibres. The Egyptian Association of Cotton Spinners and Manufacturers was admitted as a member of the federation. The organisation has 500,000 spindles and 10,000 looms affiliated to it.

A full account of the congress, including abstracts of the papers read, appears in the July issue of our sister journal, *Fibres* (*Natural and Synthetic*).

Possible Applications of Photoperiodism in Plants

R. H. STOUGHTON, D.Sc. and DAPHNE VINCE, Ph.D.

Department of Horticulture, Reading University

In this paper the authors discuss possible future practical applications of the phenomenon of photoperiodism in plants and the manner in which it may be applied to the production of new plant forms adapted to a new and wider range of conditions.

PHOTOPERIODISM is the term applied to the phenomenon of the control of flowering by day length. Our knowledge of the subject dates from 1920, when two American physiologists, Garner and Allard, showed that a late-flowering, giant variety of tobacco (Maryland Mammoth), which had been developed in the southern U.S.A., always continued a purely vegetative type of growth through the open growing season further north in Washington, D.C.; the plants were always cut off by frost in the autumn before flowering occurred. Seedlings grown in small pots in the greenhouse during the winter flowered and fruited freely, however. Garner and Allard found that these seedlings could be prevented from flowering in the winter by extending the day with electric light, and that the plants would flower in the summer if they were covered with a dark cloth daily to provide a short day of about nine to 10 hours.

In addition to the effect on flowering, the photoperiod, or relative length of day and night, has since been shown to influence vegetative growth, the formation of bulbs and tubers, the character and extent of branching, leaf shape, abscission and leaf fall, and dormancy.

The response of plants to day length

Broadly, plants may be divided into three groups on the basis of their response to length of day. First, the so-called ' long-day ' plants which require a certain number of days of exposure to periods of illumination exceeding a minimum number of hours to enable them to form flower buds. Second, the ' short-day ' plants, the requirements of which for flowering are a certain minimum period of continuous darkness; these should therefore more correctly be called ' long-night ' plants. Third, the ' day-neutral ' or ' daylength indifferent ' plants which can form their flower buds under any daily period of illumination. These three major groups can be subdivided in a number of ways according to the precise requirements of the plants falling within them; thus in the long-day group there are plants in which the relationship to daylength is quantitative, the longer the daylength or the greater the number of long days to which the plants are exposed, the greater the acceleration of flowering. Such plants will, however, flower eventually even in short days. Plants of this kind have been called ' facultative long-day plants ' in contradistinction to the ' strict long-day ' species which have a well-defined minimum daylength below which flowering does not occur, while flowering is more or less constant above the minimum. A similar division may be made within the short-day group.

Day length and flowering

From another point of view the groups may be subdivided in terms of their reaction to daylength subsequent to flower initiation. Thus, some short-day plants—for example, the strawberry—elongate their flower stems and open their flowers better in long days. Another short-day plant, the chrysanthemum, will form flower buds in long days after some delay, but these will fail to open unless short-day conditions are given. Daylength alone, however, is not always the sole factor determining flower initiation even in these photoperiodic plants; temperature often modifies or even inhibits the reaction. For example, certain varieties of chrysanthemum cannot initiate flower buds, whatever the daylength, until the plant has been exposed to moderately low temperatures for a few weeks. Many other plants may be cited which require a period of low temperature, or vernalisation, before they can respond to daylength; the biennial plants belong to this group and will fail to flower until they have passed through a winter cold period. The winter cereals afford another example. Temperature may modify

The effect of day on the flowering of chrysanthemum ' Charm.' The plant on the left received 8 hours of light each day, and the plant on the right received 17 hours

the action of daylength in other ways also, as in the chrysanthemum, where the temperature must be above 55° to 60°F. when the buds are forming in short days, or they will fail to continue their development to flowering. Such interactions between temperature and daylength are commonly encountered and are of great importance in considering the practical applications of photoperiodism.

Photoperiodic induction

An even more remarkable phenomenon, and one which could have important practical applications, is that known as ' photoperiodic induction.' The Mexican sunflower, *Tithonia speciosa*, requires exposure to long nights of about 14 hours for 14 to 21 days to enable it to initiate flower buds. Once initiation has begun, however, it continues even in long days in all subsequent shoots. Tithonia plants exposed to short days (or long nights) in the seedling stage will subsequently flower throughout the long days of summer, although untreated plants will fail to flower until the nights exceed the critical length in early autumn. This phenomenon is of widespread occurrence in both long-day and short-day plants, but the number of days required to induce flowering when the plants are subsequently exposed to unfavourable daylength conditions varies very widely. Only one short day is required to cause flowering in *Xanthium*, while 30 or more short days must be given before the chrysanthemum will subsequently open its flowers in long days. The period of time before flowering occurs, however, is usually longer when induced by a limited number of favourable daylength cycles than when the plants are grown throughout in a favourable daylength.

Specific reactions of plants

The reaction of any particular species or variety of plant to daylength or temperature is an inherent characteristic and bears no necessary relation to that of other species or varieties of the same kind, though a short-day and a long-day species rarely occur in the same genus. A short-day and a daylength-indifferent variety of the same species may, however, often be found. Photoperiodism is an important factor in the natural distribution of plants and the flowering of many plants is the result of the response to the seasonal photoperiod. In general, plants originating in tropical latitudes require short days for flowering, while those of high latitudes, roughly to the north of 60°, are long-day plants. If such plants are moved too far south, they will fail to flower as a result of the short-day conditions. When southern plants are moved to northern latitudes they will continue to grow vegetatively in the long days of the northern summer, until killed by the autumn frost, usually before flowering.

500-watt neon lamps in use on a nursery in Holland to prevent the flowering of begonia ' mother plants ' from which material for propagation will be taken

Practical applications

A knowledge of the response of any given plant to modifications of temperature and daylength may be of considerable practical importance and may well have economic significance. Already, both in scientific research and in commercial production, the photoperiodic reaction is put to useful purposes. Thus, control of the flowering date of many plants makes possible the synchronisation of flowering of varieties or species which normally flower at different times and therefore facilitates cross-breeding of the two. This may enable the otherwise desirable characteristics of, say, a late-flowering variety to be combined with the early-flowering habit of another to produce a desirable early variety. Again, in the field of plant breeding the ability markedly to accelerate flowering may allow of earlier seed production and the saving of much time in the production of successive generations.

Effect of light intensity

In commercial production application of control through the photoperiodic reaction is limited to glasshouse crops and those grown on a sufficiently intensive scale to make practicable artificial lighting to increase daylength, or mechanical shading to shorten the day. An important economic point in the former connection is that the intensity of light required to produce the reaction is normally very low by comparison with the intensities required for photosynthesis and may be produced by low wattage tungsten filament lamps suspended above the plants. Five to 10 lumens per square foot at the plant surfaces is considered to be adequate to produce a long-day effect in the majority of plants. A minimum intensity of 10 lumens per square foot is obtained from 100-watt bulbs at 4 ft. apart, 3 to 4 ft. above the plants, or from 60-watt lamps at the same spacings if reflectors are used.

Chrysanthemum

At present there is a relatively small number of crops in which flowering control is practised by the use of long-day or short-day treatments. The chrysanthemum, a short-day plant, may be delayed in flowering by artificially prolonging the daylength in late summer and early autumn and thus the benefit of better prices in mid-winter, especially at Christmas, may be obtained for some of the excellent varieties which normally flower in late November or early December. Alternatively, flowering may be accelerated by artificially shortening the day in summer by opaque covers placed over the plants in the early evening and removed in the morning. By suitable control of daylength and temperature it is, in short, possible to produce chrysanthemums in flower at any time of the year.

Begonias

Similar control of the winter-flowering begonia, an important pot plant, is possible. In this plant the normal season for propaga-

tion is from December to February, and since at this time the plants are flowering good material for propagation may be difficult to find. A very low intensity of supplementary light (about 8 watts per square metre) will suppress flowering and cause the plant to grow vegetatively and thus produce propagation material. After the cuttings have been rooted the long-day treatment is frequently continued in order to prevent flowering of the young plants. The lighting is continued until the days become naturally long enough in the spring to suppress flowering.

Poinsettas and Azaleas

The flowering of another short-day plant, poinsettia (*Euphorbia fulgens*), may also readily be controlled by daylength. By giving short-day conditions in late summer in advance of the natural season the plants may be flowered earlier than normal. After the flower crop has been cut long days are given to stimulate vegetative growth: a second crop of flowers will then occur when the long-day treatment has been discontinued in late winter, thus giving two crops of flowers in each winter instead of the usual single crop.

A long-day plant to which practical application of artificial lighting is being made is the azalea. In North-Western Europe certain varieties of the Japanese azalea are difficult or impossible to flower in time for Christmas, when the market price is at its highest. If the plants are irradiated for a few weeks with tungsten filament lamps to give continuous light, the date of flowering is considerably advanced.

Plants with which the response to daylength is quantitative may also prove suitable subjects for artificial irradiation by low wattage lamps. There are suggestions, for instance, that the carnation, normally considered to be a daylength-indifferent plant, may respond to artificially lengthened days in winter by an acceleration of its peak period of flowering, so producing more blooms at a time when prices are still high.

Conclusion

The interrelations of temperature with photoperiod are of the greatest importance and when these have been analysed in detail for the important flower crops it may well be that far greater control over flowering will be attained.

It would seem, however, that the ultimate problem lies in the discovery of the physiological mechanism of flowering. All the evidence suggests that flower formation depends upon a hormone manufactured in the leaves and transported to the growing point. This substance has defied all attempts at isolation so far, but it can only be a matter of time before its identification is accomplished. The isolation and, later, synthesis of this substance or complex of substances and the determination of its mechanism of action will provide both the research worker and the grower with a new weapon as powerful as the growth substances already known, which have had so many and such profound effects in the control of plant growth.

Endrin — A New Shell Insecticide

A great deal of interest is now being shown in the new insecticide, endrin, as the result of published reports of successful trials. Readers of this journal will recall a short article dealing with this product, then known as Compound 269, in Vol. 4, page 321, 1952. Since that date, the U.S. Inter-Departmental Committee on Pest Control has approved the word ' endrin ' as a coined, common name for Compound 269.

Endrin is the pure chemical 1,2,3,4,10, 10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8, 8a-octahydro-1,4,5,8-endo-endo-dimethanonaphthalene; it is a stereo-isomer of dieldrin, which is the endo-exo isomer. This small difference in structure has a profound effect upon insecticidal activity and gives to endrin a greater versatility than that shown by dieldrin. It is stated that endrin will, for example, control caterpillars and many aphids in addition to the range of insects controlled by dieldrin, and is, with toxaphene, the only modern insecticide officially recommended in the U.S.A. for simultaneous control of cotton bollworm (*Heliothis*) and boll-weevil.

Numerous trials in many countries have been or are being carried out or arranged by Shell Companies and endrin is being used on a commercial scale in over twenty countries. Outstanding results to date on pests of great economic importance include control of rice stem borers (*Schoenobius incertellus*, *Scirpophaga innotata* and *Chilo* spp.) in Japan, Formosa and the Philippines, of spiny bollworm (*Earias insulana*) on cotton in Iraq and Syria, of berry borer (*Stephanoderes hampei*) and ' pyrale ' (*Dichocrocis crocodon*) on coffee in the Belgian Congo, of pyrilla (*Pyrilla purpersilla*) and topshoot borer (*Scirpophaga nivella*) on sugar cane in Pakistan and India, of oak leaf roller moth (*Tortrix viridiana*) on cork oak and lackey moth (*Malacosoma neustria*) and gypsy moth (*Lymantria dispar*) on forest trees in Portugal, on fall armyworm (*Laphygma frugiperda*) on rice and cotton in Venezuela and leaf-worm (*Alabama argillacea*) and aphis (*Aphis gossypii*) on cotton in Brazil. In the U.S.A., in addition to cotton, endrin is already officially approved for the control of certain tobacco pests and also for sugar beet webworm.

The rate of application of endrin is extremely low and normally ranges from 0.2 to 0.5 lb. per acre. The product is available as the technical material, containing 90% (min.) of endrin, as an emulsible concentrate (19.5% endrin) and as dusts and wettable powders. The present list price of technical endrin is $3.75 per lb. and at this figure it is, for many purposes, highly competitive with other insecticides.

Endrin is more toxic than dieldrin to small laboratory animals, but experience has shown that it can be used without difficulty in the field provided ordinary, commonsense precautions are taken when handling the concentrated materials. Many tons of endrin have now been applied, under commercial conditions, and no case of endrin poisoning has been recorded.

At the present time endrin is available only from the U.S.A., but plans for its production in the sterling area are far advanced. It is hoped to publish a full and illustrated article on endrin in this journal early in 1955, when results from the 1954 season will be available.

I.F.A.P. General Meeting

The seventh general meeting of the International Federation of Agricultural Producers ended in Nairobi, Kenya, recently with more than 100 delegates urging governments to put programmes into effect to bring about production shifts. The most immediate problem confronting agricultural producers at the present time concerns the disposal of present heavy surpluses of certain commodities of great importance in world trade, and in this regard the Federation recommends that governments of countries possessing unwieldy surpluses consider and put into effect programmes designed to bring about a shift in production away from production of crops and livestock products now in surplus in these countries and toward production of products in greater demand in their home markets.

Mr. A. B. Kline, Iowa, was re-elected president of I.F.A.P. It was decided that the next I.F.A.P. conference would be held in September 1955 in Rome, Italy, unless the organisation's executive committee decided to change the location.

Different views of a factory blown up during the civil disturbances which occurred prior to the declaration of independence in Indonesia

The Tea Industry in Indonesia

G. C. DENHAM, C.M.G., C.I.E.

The Anglo-Indonesian Plantations Ltd.

Formerly Indonesia shared with India and Ceylon the major part in the production of tea for export. The industry was completely devastated as a result of the Japanese invasion in 1942. The present position and the outlook is assessed by the author who is the managing director of one of the largest tea producing companies in Indonesia.

BEFORE the invasion by the Japanese in 1942 of the Netherlands East Indies, as Indonesia was then called, the tea industry in that country was flourishing and expanding. Both soil and climate were favourable to the growth of tea and labour was plentiful and willing.

Tea estates

The vast majority of the tea estates were to be found in West Java which is now, and always has been, the centre of tea production. Before the invasion, in Central and East Java there were but 32 tea estates compared to the 222 estates existing in West Java. In Sumatra there were 36 estates, but as will be seen from the statistics given below, their area was outstandingly large, some of these estates being probably the largest in the world.

Peasant grown tea

Unlike most tea-producing countries, a large amount of tea is produced from peasant holdings which are numerous but small in size. Practically all these gardens are to be found in West Java. The leaf grown on these small holdings is locally known as ' kampong leaf,' in other words village leaf, and is purchased by neighbouring estates for inclusion in their own crops. There are, however, a few Chinese and Arab owned factories which deal solely in the purchase of this leaf, having no estate attached from which to draw their own leaf. Roughly speaking, the amount of kampong leaf was said to be about one-fifth that of estate leaf, but I am inclined to think that the standard production for 1942-43 was perhaps an overestimate. Tables 1 and 2 show the position as it stood before 1942 when the total Indonesian standard of production for estate and kampong tea amounted to 262,538,266 lb.

Of this amount nearly 200,000,000 lb. of tea was exported; the remainder was consumed locally, partly in the form of superior packet tea, by the more affluent tea drinkers, with a larger amount of inferior tea, usually classified as Bohea, by the workers and the villagers.

The Japanese invasion

The taking over of the tea-producing areas of Indonesia by the Japanese wrought irreparable harm and the industry has not yet been able to make more than a partial recovery. The Japanese were not interested in the production of tea and the gardens of many estates were completely uprooted or the bushes drastically cut down in order to allow for the cultivation of local foodstuffs. In some cases it is true that the tea bushes were not actually uprooted, although often collar-pruned; it might have been possible for these estates to recover had it not been the common practice for the growers of dry rice on these areas to set fire to the straw remaining after the harvest. These fires completely blasted what remained of the cut-down tea bushes.

Rehabilitation

On certain fortunate estates where the tea bushes had not been uprooted or cut down, the tea, if undamaged, grew up to a height of some 20 ft., when the task of rehabilitation was not difficult as the height of the tea had so shaded the soil that there were practically no weeds and all that had to be done was to prune the tea down. In other cases where temporary crops had been planted in the rows between the tea bushes, rehabilitation was more difficult and more expensive as, after taking two or three crops of dry rice, the badly damaged gardens were overrun by weeds, with the result that some 40% to 50% of the bushes died. It was found that it was not a paying proposition to rehabilitate gardens unless they contain 40% to 50% of fairly healthy bushes.

Damage to estates

During the occupation by the Japanese production was nil or at least infinitesimal. The damage to the estates was not confined to the destruction of their gardens as during the civil disturbances which ensued after the Japanese surrender a very large number of factories were burned down, no less than 168 factories out of a total of 266 being destroyed. The loss of these factories and the reduction of the area under tea from 341,000 acres to 188,000 acres (see Table 3) was a blow from which, in these days, it must be admitted, total recovery is really impossible.

Obstacles to rehabilitation

Many attempts at rehabilitation were doomed to failure owing to the lack of security and because in many instances the local population had occupied the devastated estate areas and established themselves as semi-permanent rice growers, having built their own villages on estate land. Even when it is possible with Government help to re-occupy such lands, the actual cost of replanting owing to the present high wages would be exorbitant and the building of a new factory would indeed require financial resources which, after so many years of disaster, very few tea estates still possess.

Blister blight disease

In discussing the rehabilitation of the damaged tea estates, one must bear in mind the disastrous attacks of blister blight which have done enormous damage to every tea estate in Indonesia. These attacks commenced in 1950 in Sumatra and spread to Java in 1951. At the commencement of these attacks no estate was

TABLE 1
NETHERLANDS INDIES BEFORE 1942

Territory	*Number of estates*		*Number of leaf buying factories*	*Standard producing area (acres)*	*Standard production 1942-43 (lb.)*		
	Over 124 acres	*Under 124 acres*			*Estate leaf*	*Bought leaf*	*Total*
Java							
West	222	37	22	228,994	130,969,367	45,724,935	176,694,302
Central ..	17	2	—	16,460	11,078,649	239,036	11,317,685
East	15	2	—	12,869	7,559,469	54,750	7,614,219
Total Java ..	254	41	22	258,323	149,607,485	46,018,721	195,626,206
Sumatra							
South and West	15	4	—	25,942	24,445,527	—	24,445,527
East Coast, including Atjeh	21	—	—	57,263	42,466,533	—	42,466,533
Total Sumatra	36	4	—	83,205	66,912,060	—	66,912,060
Total Indonesia	290	45	22	341,528	216,519,545	46,018,721	262,538,266

TABLE 2

Size of estates	*Estates*		*Area*	
	Number	%	*Acres*	%
Up to 61 acres	34	13	1,028	0.3
From 62 to 123 ,, ...	11	5	1,483	0.5
,, 124 ,, 247 ,, ...	29	8	5,340	1.6
,, 248 ,, 617 ,, ...	47	13	21,012	6.1
,, 618 ,, 1,235 ,, ...	108	31	100,077	29.3
,, 1,236 ,, 1,853 ,, ...	60	17	90,469	26.5
,, 1,854 ,, 2,471 ,, ...	21	6	44,643	13.0
,, 2,472 ,, 3,088 ,, ...	14	4	37,645	11.0
Larger than 3,088 ,, ...	8	3	39,831	11.7
	335	100	341,528	100

(*Left*) Tea not yet cut down, together with tea which has been brought back to normal and again in pluck (*Right*) Cutting down high tea. In the background is tea not yet brought down

TABLE 3

ESTATE AREA, INDONESIA, BEFORE 1942 AND PER MID-1952

Territory	*Number of estates (factories)*		*Area (acres rounded off)*		
	Before 1942	*Mid-* 1952	*Before* 1942	*Mid-* 1952	% 1952 *of* 1942
Java:					
West	222 (202)	132 (80)	230,000	141,000	61
Central	17 (17)	7 (5)	17,000	5,000	29
East	15 (14)	6 (4)	12,000	5,000	40
Total Java	254 (233)	145 (89)	259,000	151,000	58
South and West Sumatra	15 (13)	4 (3)	25,000	12,000	50
Total A.L.S./Z.W.S.S. territory ..	269 (246)	149 (92)	284,000	163,000	57
AVROS—territory:					
Sumatra East Coast, including Atjeh	21 (20)	6 (6)	57,000	25,000	44
Total Indonesia	290 (266)	155 (98)	341,000	188,000	55

equipped with the means of combating them and it took a considerable time for proper spraying and dusting machines to be purchased and the labourers instructed in their intelligent use. The expense incurred in the treatment of blister blight must necessarily depend on its severity which varies considerably with the elevation of an estate and the prevalent humidity. Losses of crop were very heavy, probably something in the region of 25%; it is, however, now estimated that with proper and efficient treatment the loss of crop is comparatively small; the expense incurred seems roughly to be in the nature of 3d. per lb. of made tea, though at the commencement of the attacks the cost was considerably higher. If this expenditure were not incurred annually it is estimated that production would immediately drop by some 15% and that this loss of crop would increase year by year until eventually most of the weakened bushes gradually died.

Export production

The production of tea for export in Indonesia at present is barely 80,000,000 lb. and there seems little chance of any marked increase in the immediate future. It is true that the internal consumption of tea, mostly of an inferior type, is somewhere in the region of 30,000,000 lb., but the greater part of this could not be exported owing to its poor quality.

The outlook

I have stressed above the difficulties which would be incurred in any attempt to plant up new areas and equip them with efficient factories, but it may be possible for certain estates to increase their acreage of tea where they are also growers of quinine, as the world demand for quinine has so diminished that areas bearing quinine have been allowed to go out of cultivation and might be converted to tea at less cost than that which would be incurred by the opening of new areas. In cases where the land has been occupied by the population, the soil has seriously deteriorated owing to the successive plantings of dry rice. This means that before replanting tea it would be necessary to re-afforest the area and keep it afforested for a number of years so that the soil can regain its fertility.

Costs and wages

When considering the possibility of the expansion of the tea industry in Indonesia, I have emphasised the cost involved, and here I refer particularly to the wages paid and the amenities demanded by the labour unions. The estate owner these days is required to provide a large amount of free food which is not only given to the worker but to his wife and family. The expenditure involved in providing rice and food is extremely high and very hard to control, and to check the number and age of children, all of whom benefit by this system of payment, is extraordinarily difficult. In short, the employer is asked by labour to pay for welfare and thus relieve the Government of the burden which is incurred by the modern welfare state.

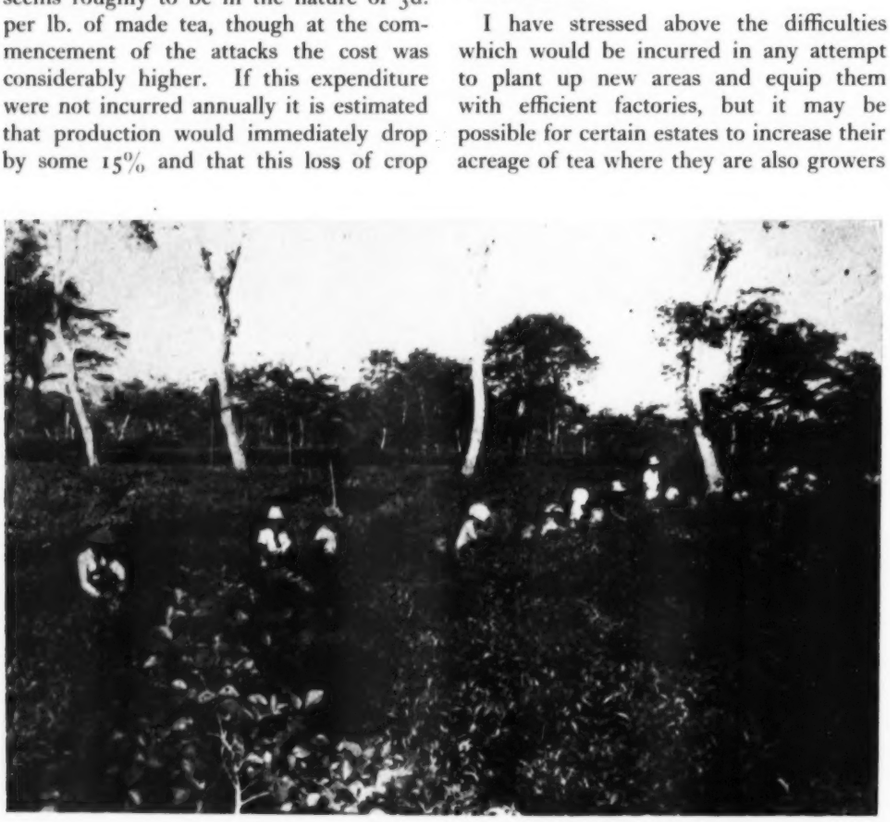
Estates abandoned

So heavy have become the costs of production that until the price of tea recently rose several estates were unable to continue in production and were either handed over to the Government or entirely abandoned. There are no up-to-date statistics showing the area and production of these estates, but undoubtedly their collapse has reduced still further the falling output of tea in Indonesia.

Conclusion

Should the hours of work be lengthened and the cost of labour be reduced by the Government bearing the burden of state welfare, then once again Indonesia might take its true place in the ranks of the large tea-producing countries. It is the hope of every planter that he will see successful rehabilitation and extensions on his estates which will in time lead to an expansion of the production of tea in Indonesia.

The achievement of this must depend in the last resort on the policy of the Indonesian Government, but it seems not unreasonable to hope that in the end it will be appreciated that the rehabilitation of the tea industry is essential for the restoration of Indonesian prosperity.



Plucking in a normal high garden

Recent Research on Arabian Coffee

A. E. HAARER, F.L.S., Dip.Hort.R.H.S.

In this article the author reviews the results of recent research on cultural practices in relation to Arabian coffee in East Africa.

THE orchard crop Arabian coffee has been dealt with in so many countries by agriculturists and not by horticulturists, that practices became common which were more applicable to farming than to horticulture. Gooseberry bushes in England are planted carefully in holes not much less than 2 ft. 6 in. wide by 2 ft. deep, and the holes are left open until the bush is ready to plant, so that the roots can be spread out to their full extent and the soil firmed surrounding them as the task is done.

Planting methods

In Brazil, on the other hand, much of the coffee has been reared from seed sown at stake, and even in East Africa today coffee is planted in very small holes, which for some curious reason it is usual to fill in again before planting. It is feared, apparently, that the soil may sink and the bushes be set too deeply if the holes are filled when planting takes place, and so they are filled a month beforehand, and then partly dug out again to give space for the roots of the coffee—a curious proceeding that must lead to the cramping of the roots, which is more serious than deep planting. Surely the act of firming the soil and planting at the right level is merely a question of proper skill and supervision? The writer has planted many thousands of coffee trees according to horticultural practice with satisfactory results.

The following results of experiments carried out in Kenya illustrate this point:

TABLE 1
SIZE OF PLANTING HOLES EXPERIMENT
SIX-YEAR TEST.

Size of hole	*Average yield of cherry per tree in lb.*	
	Scott Agricultural Laboratories, Kenya	*Kitale Experiment Station, Kenya*
6 in. by 6 in.	20.6	—
1 ft. by 1 ft.	23.4	21.9
1½ ft. by 1½ ft.	24.8	22.2
2 ft. by 2 ft.	23.6	23.3
2½ ft. by 2½ ft.	—	24.0
3 ft. by 3 ft.	26.3	24.0

Although there may not perhaps be enough difference to be mathematically significant, yet the trend of increasing yields as the size of the holes is increased is clear, and is sufficiently regular to indicate an obvious benefit. The yield given is per tree, so the aggregate increase per acre must be considerable.

Effect of planting methods on yield

In many experiments it has been shown that the initial treatment given when the plants are set out in the field has a residual and lasting effect throughout the life of the coffee tree. Beneficial treatments probably assist young trees to build stronger root systems, stronger stems, and stronger branches. This may help them to withstand exhaustion after cropping better than can weaker trees and thus bear bigger crops.

Experimental evidence

This is shown in an experiment to discover the best time for holing, carried out at the Lyamungu Experiment Station in Tanganyika Territory (Table 2).

The experiment appears to show that if the holes are made three months before planting, and left open for the first two months, the coffee is benefited. Some advantage may be gained from weathering, but it would seem that extra moisture caught and held by the open holes, is likely to be the chief factor; this experiment in fact seems to indicate that sub-soil moisture in sufficient quantity is of vital importance. Another experiment at Lyamungu to determine whether 'ball planting' or bare root planting had any effect, is of greater interest and importance to planters. At the same time it was shown that deep planting was definitely harmful throughout the life of the plants (Table 3).

The effects of deep planting were as expected, but the surprising thing is that no difference is found between bare root and the so-called ball planting. It seems that no one need worry if the soil falls off the roots when plants are taken from the nursery to the field, provided the young plants are given normal care. The term ball planting is in fact a bad one. Whereas it means transplanting with as much earth as possible attached to the roots, it misleads untrained people into thinking that the soil should be pressed round the roots in the shape of a ball when the plants are transferred, which, of course, would be most unwise.

TABLE 2

Treatment A. Holed three months and filled one month before planting
" *B.* Holed one month and filled one month before planting.
" *C.* Similar to *A* but subsoiled
" *D.* Similar to *B* but subsoiled

TEN-YEAR TEST. YIELDS IN CWT. CLEAN COFFEE PER ACRE.

Treatment	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	*Average yield*
A	7.90	1.13	6.85	11.67	4.98	17.42	—	27.73	—	25.77	10.54
B	5.65	1.43	5.35	10.76	3.89	11.87	—	27.55	—	22.84	9.30
C	7.78	1.17	6.51	12.30	3.81	14.77	—	26.14	—	24.21	10.02
D	6.11	1.53	5.46	11.43	3.70	13.24	—	25.19	—	23.71	9.34

TABLE 3

Treatment A. Planted 6 in. too deep with earth attached to the roots
" *B.* Planted 6 in. too deep with bare roots
" *C.* Planted at nursery level with earth attached to the roots
" *D.* Planted at nursery level with bare roots

TEN-YEAR TEST. YIELDS IN CWT. CLEAN COFFEE PER ACRE.

Treatment	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	*Average yield*
A	6.22	1.26	4.97	11.20	3.76	14.36	—	25.83	—	22.30	9.27
B	6.50	1.10	5.02	10.54	3.87	13.37	—	24.85	—	21.38	8.89
C	7.85	1.68	6.35	12.03	5.80	15.10	—	26.81	—	24.07	10.28
D	7.24	1.49	5.32	12.56	4.36	15.29	—	28.14	—	23.86	10.32

NOTE.—Due to climatic conditions the crop failed entirely during the years 1944 and 1946

Shade and altitude

It is now generally accepted in East Africa that shade for coffee is required 'below an altitude of 5,000 ft.' This might not apply elsewhere because altitude is linked to latitude, and may embrace a multitude of varying environments some of which might be inimical to coffee. Successful coffee culture depends, of course, on a whole set of circumstances which must combine in the right way, these being temperatures, rainfall, humidity, light range and intensity, type of soil and protection from wind. However, the question arises how should young coffee be shaded until the permanent shade trees have grown in regions where shade is required.

Many planters have used what is known as temporary shade crops, *e.g.* pigeon peas, tall growing species of *Sesbania*, *Leucaena glauca* and various species of *Crotolaria* or *Indigofera*; these are sown in proximity to the young coffee. That this practice may be harmful is shown by an experiment at Lyamungu which was begun for quite a different reason. Plots on sloping land were treated in various ways, including the sowing of cover crops, hedge crops and temporary shade plants with a view to preventing soil erosion, with results shown in Table 4.

Rainfall and erosion

Where the rainfall is no more than 40 to 50 in. per annum, all the rain that falls must be encouraged to soak in by using conservation treatments, so that the deficits in the sub-soil during the drier months may be made up during the wet season. To encourage weeds in the wet season may not be wise if other methods of erosion prevention can be provided.

The erect cover crop gave the poorest results, and the results of the experiment may be summarised by saying that although cover crops and live hedges may be efficient as anti-erosion measures, they could not be adopted in the neighbourhood of Lyamungu unless irrigation is available, because of their harmful competition for soil moisture.

It would seem, therefore, that cover crops and temporary shade may be harmful to coffee, principally because they may cause a moisture deficit in the sub-soil during the drier months of the year. The same might be said for weeds, because these must be harmful too, except during the wettest months of the year in a high rainfall area.

Shade and mulching

Arabian coffee does not in fact need overhead shade during the first few years of its growth until it bears its first heavy crop. If permanent shade trees have been planted they should be giving a fair amount of shade by the time they are three years old. What in all probability is required more than anything else is soil cover in the form of a mulch, and the benefits to be derived from mulching have been proved by experiments in Uganda, Kenya and Tanganyika.

Arabian coffee beginning to bear on the older wood at 5,000 ft. S.E. Kilimanjaro Mountain

Mulching experiments

Experiments in Uganda showed that mulching with a 9- to 12-in.-deep cover of cut Napier grass encourages the production of a crop three times as large as that from manured plots, and five times that from the controls. After mulching had been carried out for some years it was, however, found better to apply mulch to alternate rows every year, since this kept the soil in better texture. This is borne out by experiments in Kenya which gave yields of clean coffee per acre of 7.63 cwt. for alternate row mulching, 7.02 cwt. for complete mulching and 4.72 cwt. for box-ridged bare soil controls. Although Napier grass, *Pennisetum purpureum*, is considered a good mulch in Tanganyika, banana trash is preferred and has given better results. A ten years' trial at Lyamungu gave an average yield of 8.99 cwt. of coffee per acre for plots under banana mulch at the rate of 80 lb. of mulch per tree; 8.69 cwt. for plots mulched with elephant grass at the same rate; and 7.71 cwt. for the controls without mulch.

Nitrogen in mulched soils

A report written by the soil chemist at Lyamungu gives interesting information about the nitrogen status of mulched soils.

TABLE 5

Treatment	*Nitrate nitrogen in parts per million of soil*		
	A	*B*	*C*
Banana leaf mulch	37.0	18.0	37.0
Grass mulch ..	23.5	14.0	18.0
Bare soil	18.0	12.5	21.0

The fall in nitrate content from *A* to *B* was the result of 33 mm. of rainfall. *C* represents the conditions three weeks later, after a period of warm weather with occa-

TABLE 4

YIELD IN CWT. CLEAN COFFEE PER ACRE. EROSION LOSS IN TONS OF SOIL PER ACRE.

Treatment	1938		1939		1940		*Mean*	
	Yield	*Erosion*	*Yield*	*Erosion*	*Yield*	*Erosion*	*Yield*	*Erosion*
Clean cultivation ..	3.87	2.90	1.83	0.74	3.08	—	2.93	1.82
Hedges of *Crotalaria* on mounds	4.85	1.84	1.37	0.30	1.68	—	2.63	1.07
Hedges on mounds and cover crop	4.94	1.44	0.96	0.26	2.54	—	2.81	0.85
Cover crop alone ..	5.20	0.94	0.91	0.18	3.34	—	3.15	0.56
Erect cover crop of *Crotalaria*	4.83	3.72	0.74	1.27	2.04	—	2.54	2.49

sional light showers. Banana trash resists decomposition and is a more effective soil cover, conserving the soil moisture and helping to maintain even temperatures.

The objections to mulching are (*a*) danger of fire, and (*b*) expense. Banana trash does not catch fire so easily as dry grass, but even so, with proper fire breaks and alternate row mulching the danger from fire should not be very great. As for the expense, this is more than compensated for by the additional yields, the health of the trees, the avoidance of weeding costs, and the protection given against erosion. It has been proved at Lyamungu that combined with contour terrace-ridging mulching is the finest aid to prevent erosion.

Selected strains

Arabian coffee often overbears its strength, and it might seem unnecessary to bother about selecting mother trees of good average yield were it not that some strains appear to have better stamina than others; they yield heavier crops without the same amount of exhaustion, and, perhaps, more regular crops for this reason. Proof of the value of selection is given by the Kent's strain of Arabian coffee which originated in India. Kent's coffee is not only definitely resistant to Hemileia leaf-spot disease but it will resist infestation by pests such as the green scale up to a point. The yielding capabilities of Kent's and Bourbon coffee have been compared at Lyamungu, and in most situations Kent's appears to be superior.

TABLE 6

Year	*Clean coffee in cwt. per acre*	
	Kents	*Bourbon*
1938	7.69	7.12
1939	4.86	3.11
1940	3.70	5.10
1941	12.87	9.51
1942	5.72	9.34
1943	11.84	8.01
1944	12.90	9.20
1945	5.65	2.97
Averages	8.15	6.80

The most striking feature which can be seen over a long period of years of progeny testing is not the fact that the progeny vary, as might be expected, but how the trees, and especially those pruned to the single-stem system, gradually increase their yields. In the first five years of cropping yields are nothing like those of the parent mother trees, but at the end of nine years the yields begin to approach those of their parents. One of the tables extracted from the Lyamungu reports bears out these statements (Table 7).

TABLE 7
SINGLE-STEM PRUNING. CWT. OF CLEAN COFFEE PER ACRE.

Parent		*Progeny seedlings planted May 1938*											
Years of record	*Average yield*	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	*Average yield*
7	7.13	1.32	2.65	6.82	8.42	3.94	5.02	16.32	4.14	14.00	6.35	17.55	7.87
5	15.00	1.21	4.35	7.01	7.87	2.55	4.85	13.84	1.80	12.15	5.48	14.57	6.88
5	11.88	0.95	4.60	6.17	8.30	2.57	4.45	13.78	4.37	12.12	6.63	17.73	7.43
5	12.32	0.84	2.07	4.43	6.38	1.19	5.31	9.75	4.63	9.42	5.05	14.90	5.81
5	13.17	0.73	1.57	3.82	5.96	1.54	4.20	10.09	4.88	8.99	6.32	15.19	5.75
5	13.34	0.77	1.29	1.53	3.69	0.87	3.63	6.56	6.78	6.22	5.87	11.70	4.45
Means		0.97	2.76	4.96	6.77	2.10	4.58	11.72	4.43	10.50	5.95	15.27	6.36

In regard to experiments at Lyamungu the years 1945 and 1946 appeared to be bad ones. It will be seen that in spite of this the crops increased steadily over a period of four years, though the first bad year caused the following crop to be very poor. Some recovery was noted during the second bad year (1946), and a maximum yield was generally obtained for all the selections in 1947. Thereafter a tendency towards biennial bearing began.

Pattern of yields

In the tabulated yields of Kent's variety selections at Lyamungu, recorded for a period of 14 years, page 23 of the 1951 report, the rhythm of bearing for different trees and plots appears to have no distinctive pattern. Some trees bear good crops for three successive years, then a poor one occurs followed by three good, two poor, two good, three poor years. Others become biennial after a heavy crop has brought exhaustion. If, however, the yields of 39 selections are added up every year, the average is about the same despite good and poor years. It is therefore obviously dangerous to make sweeping statements such as to imply that only a small proportion of trees on any one plantation bear a big proportion of the crop. Trees that bear regular crops year after year have not apparently been found, yet there are some with outstanding stamina and yields.

Vegetatively propagated plants and seedlings

The next point concerns the question as to whether trees propagated vegetatively from the best selected mother trees will yield better than mixed seedlings, and in this regard the results are startling (Table 8).

TABLE 8
LYAMUNGU TEST. TREES PLANTED IN 1938.

	Yields of coffee in cwt. per acre	
	Clonal trees raised from cuttings	*Seedlings of same parent*
1948	8.83	12.16
1949	15.75	16.12
1950	9.09	12.80
1951	14.37	15.08
Average	12.14	13.94

This difference is significant, and shows that when trees grow to be 10 years old, seedlings from clonal stock may give better yields than plants that have been propagated vegetatively. To sum up on the question of selecting mother trees, (*a*) it is possible to find trees of outstanding performance though the yields may be somewhat irregular throughout the years, (*b*) it appears to be better to use clonal seed and to plant seedlings, than to propagate by cuttings from mother trees and plant these in the field. Vegetatively grown clonal material is required by the research worker, but it is not the best for productive purposes.

Pruning

All the agricultural advisory services in Uganda, Kenya and Tanganyika now favour the multiple stem system of pruning, and state that yields are much better. They certainly may be at the lower altitudes where the environments are not ideal, because in such regions Arabian coffee bears on its young wood. With single stem pruning, trees may overbear and produce many exhausted and dead branches which cannot easily be regenerated. The multiple stem system of pruning is also simple to operate with semi-trained pruners, economic to carry out, and relies on the constant production of young wood.

Even where Arabian coffee finds itself growing in happier conditions, such as at Lyamungu, a long period of tests exhibit a difference in yields between single

TABLE 9
CWT. OF CLEAN COFFEE PER ACRE.

Treatment	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	*14-year average*
Single stem	1.98	2.99	7.29	3.95	5.31	5.31	9.39	1.04	20.49	9.32	5.05	12.36	15.81	7.76
Multiple stem	2.35	11.93	12.96	12.03	17.24	5.68	7.08	2.30	29.58	5.06	12.70	13.45	16.24	10.63

stemmed and multiple stem pruning which are interesting (Table 9).

It is, however, doubtful whether the multiple stem system would be the best in a region where Arabian coffee finds its ideal surroundings, such as the south-eastern slopes of Kilimanjaro Mountain above 5,000 ft. where the trees definitely bear on their old wood, and not on the young wood. Multiple stem pruning under these conditions sacrifices the old wood, and would thus be the wrong system to use.

Cultivation

It is becoming established, and quite rightly so from the point of view of horticultural practice, that cultivation should not be carried on in coffee plantations after they are two or three years old. It is far better to mulch and not disturb the coffee roots. Many trials have been made in India, and also in East Africa in regard to the use of both organic and inorganic manures. Seldom have there been significant results. In no case does manuring over a period of years have much effect on yields other than a depressing one. The natural leaf fall from shade trees, and a grass or a banana trash mulch to conserve moisture, appear to be all that is needed by Arabian coffee trees in these countries.

Summary

Research has shown that the health and yields of coffee trees in later years are affected by initial treatments which probably build up the strength of the trees before they begin to bear, hence a large hole at planting time is better than a small one, and holing out for several months before planting has its advantages. Of especial interest to the planter is the knowledge that careful bare-root planting has no significant depressing effect in comparison with the so-called ball planting. In any area that is short of rain it is doubtful whether weeds should be left growing in the wet season. Cover crops are definitely harmful, and so is temporary shade, since they compete for sub-soil moisture with a likelihood of creating a deficit. Mulching instead brings increased yields, reduced costs, and preserves the nitrogen content of the surface soil.

Selection work in Arabian coffee fields proves that the rhythm of bearing from tree to tree varies a great deal, often irrespective of season. Although regularity is difficult to find, it is possible to discover trees which, over a period of years, are outstanding in yield. In spite of a certain amount of irregularity among progeny seedlings from mother trees, it is better to plant clonal seedlings rather than trees vegetatively produced by cuttings from a selected mother tree.

Arabian coffee bears its crop in two ways, according to whether its environment is exact or not. Multiple stem pruning that ensures a regeneration of young wood is proved to be the best when coffee bears on its young wood. Single stem pruning may still be the wisest method to use, however, in those favoured localities where the coffee bears mostly on its old wood.

REFERENCES

1. 'Annual Reports, Department of Agriculture, Kenya Colony, 1941-50.'
2. 'Annual Reports of the Coffee Research and Experiment Station, Lyamungu, Moshi, Tanganyika, 1936-51.'
3. Dr. J. D. Tothill *et al.*, *Agriculture in Uganda*, O.U.P., 1940.
4. J. K. Matheson and E. W. Bovill, *East African Agriculture*, O.U.P., 1950.
5. 'Annual Reports, Research Dept., Indian Coffee Board, 1947-51.'

Photos: pp. 318 and 320, East African Office.

Sacks of coffee berries being taken from the farm to the factory

Agricultural Surpluses

The economic committee of the Inter-American Conference at Caracas, Venezuela, has urged international consultation before agricultural surpluses are sold in world markets. The committee suggested this to avoid harming normal production by other countries. It also recommended that the surpluses should not be destroyed.

On international trade, the committee recommended industrialised countries to eliminate restrictions on the importation of raw materials and semi-manufactured products from American countries.

To Authors and Readers

The publishers of WORLD CROPS invite the submission of manuscripts of books to be considered for publication. All manuscripts will be promptly acknowledged and carefully considered by qualified experts. A synopsis with chapter headings should be sent in the first instance, addressed to the Book Production Manager.

The publishers are specialists in industrial, technical and scientific books, and have a world-wide selling and distributing organisation.

Contrasts and Comparisons

A. C. BARNES, C.M.G., B.Sc., F.R.I.C.

Sugar Consultant

Comparison between the methods employed in cultivating any crop in different parts of the world are always instructive. In this paper Mr. A. C. Barnes contrasts the methods used in cultivating sugar cane in Natal with those employed in some other sugar growing countries. Mr. Barnes will be well known to our readers as the author of many papers on the sugar industry in various countries. He is now established in Durban. The paper originally appeared in the South African Sugar Year Book.

IT is often remarked that in many respects the sugar industry of Natal displays unusual features, even to the extent that in comparison with some other countries the conditions encountered by the planter cause wonder that sugar is produced at all. The fact is that yields and costs compare favourably with those of regions where climate, land configuration and other circumstances confirm more closely to what are regarded almost as standard requirements for the commercial success of cane sugar enterprises.

The major disadvantages arise from the climate and topography of the greater part of the sugar belt. Some of the soils, particularly the wind-blown sands, would not appeal to the cane planter in the alluvial flats of Louisiana, while the irrigation engineer accustomed to easily-won water and gently undulating, almost flat, country would be astonished to see the extensive system which serves the rolling hills of Natal estates by water pumped 498 ft. above the level of the Umgeni River. The terrain of the Natal sugar lands contrasts remarkably with the landscapes of Louisiana, Florida, British Guiana, and in fact most other sugar cane regions. Parts of Zululand, the northern portion of Natal, are in many respects similar to the flat and gently undulating lands devoted to cane in the West Indies. These districts require drainage and lend themselves to furrow irrigation where adequate water is available.

Significant points

It is significant that South Africa enjoys high-grade sugar for domestic consumption and industrial use at the lowest price in the world, and the price of sugar per ton for these purposes is so remarkably less than the export value. Domestic consumption has increased at a greater rate than total output, and though the industry continues to expand, there appears no early possibility of exporting at the levels of the period 1930 to 1939. The organisations of the industry, combined with the effects of various Government controls and the favourable general economic conditions in the Union, has avoided the steep increases in production costs of sugar such as have occurred, for example, in the Caribbean region, with no check on improvements in conditions of employment and standards of living of employees of all grades. Production efficiency in all phases of field and factory work is high, but there is no complacency or neglect of opportunity for further advancing the standards of performance. The absence of stoppages of work caused by labour disputes is a tribute to the conditions of employment and to the machinery provided for the consideration and conduct of labour affairs, as well as those who participate in its operation.

The location of the sugar lands of Natal in relation to other principal cane sugar-producing countries is shown diagrammatically in Fig. 1. It will be noted that

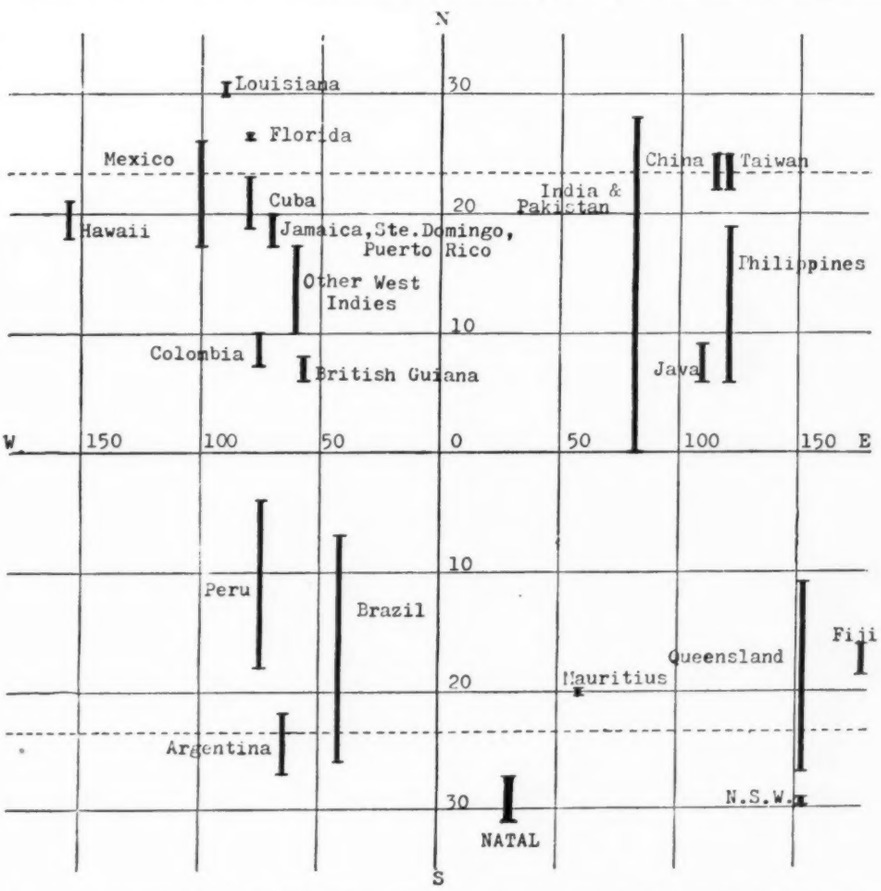


Fig. 1. Geographical distribution of the cane sugar industry of the world. This diagram indicates the latitudes of the cane areas of the principal sugar-producing countries. The approximate longitude of the central meridian of each region is shown to a smaller scale

Natal is the farthest south of the equator, and that it shares with Louisiana in the northern hemisphere the distinction of highest latitude. Although sugar cane does not attain full growth and maturity so quickly as in the hotter and wetter regions of the tropics, the combination of climate, soil and varietal character produces crops which compare not unfavourably in yield and quality with those of countries regarded as enjoying conditions better suited to it. The rainfall of Natal is exceptionally low for cane areas in which irrigation is not standard practice, while the distribution is erratic. The mean annual rainfall for the sugar belt is 39.9 in. Fig. 2 illustrates the monthly distribution at the South African Sugar Association Experiment Station at Mount Edgecombe compared with that of other places; but the remarkable differences in quantity and incidence of rain bear less relation to the adequate supply of water for profitable cane production than is apparent. The sugar estates of south central Jamaica, with much higher mean rainfall, are entirely irrigated; they could not otherwise continue to produce sugar. In British Guiana, where cane is grown under unique conditions, irrigation is essential during the two ' dry ' periods of the year, despite the fact that the rainfall of those months very closely approaches the annual total for Natal. In contrast to thse two regions, the annual mean rainfall of Antigua of 43 in. is not supplemented by irrigation. The southern districts of Queensland provide another comparison, with rainfall and its distribution somewhat similar to Natal. Some irrigation is practised, and winters are colder with considerable frost damage to cane at times.

Natal cane, however, is not produced with lower total rainfall and its requirements in terms of effective applied water to attain full growth are no different from those of the same varieties in other countries where annual rainfall alone, or with added irrigation water, is in greater quantity. The cane is simply left for a longer time before reaping, so that both plants and ratoons may be as much as 24 months old at harvest. In Hawaii soil, climate and available water make it possible to grow cane to the same or a greater age, and most of the cane is cut at two years, though in a few areas it may stand for twice as long. Total yields of sugar are in approximate proportion to the age of the cane when reaped at maturity, but the rate of increase varies considerably.

Comparative yields

A useful figure for such comparisons is the weight of sugar per acre per month

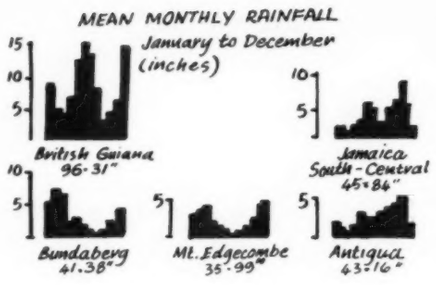


Fig. 2

obtained by dividing the factory yield of 96° sugar by the age of the cane in months at the time of reaping. Suitable corrections in respect of factory performance are applied for the derivation of truly comparative figures, but they need not be discussed in the present connection. Hawaii in 1947 recorded a yield on this basis of 760 lb. The 1949 crop of the ' estates ' in Jamaica, representing two-thirds of the total production, reached 644 lb., the average age of the cane at reaping being 12.65 months for plants and ratoons. The Natal average is of the order of 400 lb., a creditable figure in relation to the interruption of cane growth which occurs in the cool dry season of four to five months.

From the viewpoint of geographical location, Louisiana and southern Queensland would be expected to display the greatest similarity to Natal in respect of temperature and the general conditions of cane growth apart from rainfall, but the Natal winter is warmer and, though little growth occurs, cane carries over to resume more rapid development and matures during the latter half of its second year. Louisiana winters are much more severe, and standing cane is so seriously damaged that an early frost occurring before the crop has been reaped may cause heavy loss. The period of growth is thus limited to a maximum of ten months, and though cane is planted in the fall of the previous year, growth occurring before the onset of winter is damaged and destroyed by frost, and must be removed before the development of new shoots takes place in the spring.

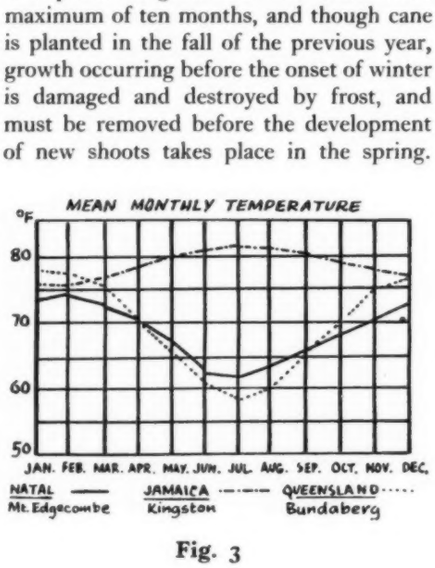


Fig. 3

Freedom from high intensity cyclonic storms such as those experienced in Fiji, the West Indies, Mauritius, Queensland, and other places in the northern and southern hurricane zones, relieves the Natal industry from the risk of costly damage to crops, buildings and equipment, and the expense of insuring against it. Heavy winds of gale force occasionally occur, but factory and farm buildings do not require to be designed and constructed to withstand winds of hurricane force. The high intensity of rainfall which inevitably accompanies hurricanes ravages, land and cane, and the combined effect of wind and water may result in the loss of one-half of a crop, as it did in Mauritius in 1949.

The subject of contrasts includes many matters which are sometimes regarded as of rather minor importance. It is probable that the planters and millers of Natal rarely or never think of earthquakes and their possible effects. These terrifying, devasting outbursts of nature do occur in some other sugar countries and may cause havoc to buildings and machinery. When the combined risks of hurricane and earthquake are encountered, as in Jamaica, structural strength and design become much more important than for hurricane hazards alone, and insurance is still more expensive. A large cane mill running at full load with two tons of cane per minute going through, and all the rest of the heavy complex plant of a sugar factory in action, has operated through, and survived without damage, an earthquake which cracked and shattered houses and farm buildings. In quaky countries, the people are supersensitive to shocks, and in the case referred to the operatives evacuated the factory on the instant, leaving the shift engineer, who happened to be on the mill platform at the time, standing alone like Casabianca.

A great advantage enjoyed by Natal is the duration of the harvesting period, which normally extends from May to December and may continue until February. Thus a lower average grinding rate by the mills is required for the same weight of cane in comparison with most other places, and a lesser capital investment in proportion to the crop is needed for the factories.

Other advantages

There are other notable advantages which favour the industry in Natal. Close drainage is not required as in Louisiana, Florida and the Caribbean region. Post and wire fences, an expensive feature of the cane landscape in Jamaica, are rarely seen. Pests and diseases do not

affect the cane to any serious extent, and the weed problem causes little trouble. The climate is largely responsible for delayed germination of cane setts, and until treatment by ' Aretan ' was generally practised, losses of plant material were caused by pineapple disease. The simple method of immersing each end of the seed piece in a solution of 1 oz. of ' Aretan ' in 1 gallon of water has removed this danger, and under normal conditions there is now no difficulty in getting good stands of cane. Both field and factory are well served in respect of requirements for new machinery, spares and repairs for the maintenance of equipment.

Although all cane is hand cut, and almost entirely manually loaded, its degree of freedom from tops and trash compares unfavourably with the West Indies. Much of it is burned before reaping, a practice which is happily declining but it is often replaced by the firing of the cane as it stands in rail cars in the factory yard. This feature, combined with the protracted delays which often occur between reaping and milling, causes processing difficulties and factory losses which could be avoided if cane reached the mill in fresh and clean condition.

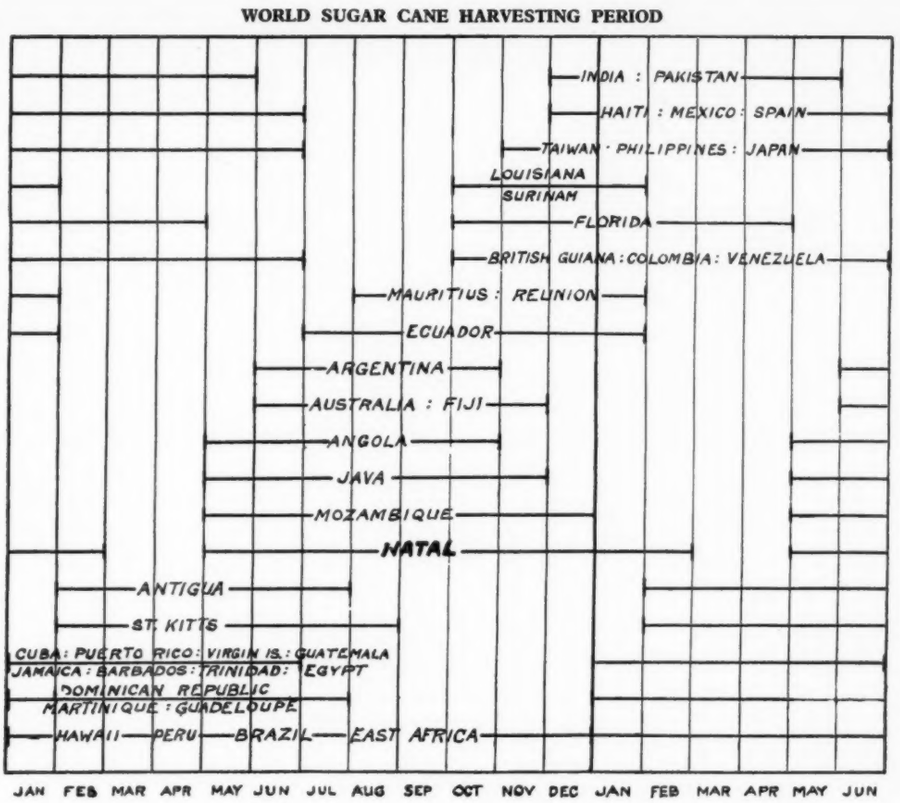


Fig. 4. This shows the normal months of cane harvest and sugar manufacture of the principal cane sugar-producing countries. These operations may start a little earlier and start later in limited areas where special conditions occur

Mechanisation possibilities

Mechanisation offers great possibilities of economy in time and effort in connection with field loading in cars on narrow gauge track, and transfer to the main line trucks of the South African Railways when that operation is necessary. Various methods of mechanical handling in the field are under trial, and advances in general practice may be expected. The transfer problem is more difficult principally because of administrative policy. It may therefore take longer to arrange for the installation of the necessary equipment at main railway sidings, with which must be combined changes in methods of securing loads in primary transport vehicles. Under present conditions there is great waste of time and human effort, as well as material loss by wastage and deterioration. These drawbacks are to some extent inevitable when a heavily loaded public transport system encounters seasonal traffic amounting to a total measured in millions of tons over comparatively short runs. The time loss is a vitally important matter at all stages, particularly when it involves spoilage and interruption of milling operations.

It has been recognised for some time that mechanical methods must replace manual labour to an increasing extent if the industry is to advance, keep pace with expanding demand, and operate efficiently in all its phases. It is not so much that cheaper working is achieved, as that more work can be done with greatly reduced output of human energy, while time and material can be saved and conserved. The details of cane handling and transportation offer an outstanding opportunity for improvement. A commencement has been made, but the difficulties of co-ordinated working between the successive transport system have not yet been overcome, and will take time to resolve.

The value of factory wastes and by-products throughout the sugar world is appreciated in different degrees, ranging from full utilisation to complete discard. Natal molasses provides raw material for chemical industry conducted away from the sugar factories, which includes the manufacture of power alcohol, anaesthetic ether, ' dry ice,' and materials used in ore flotation.

In contrast with the Caribbean, no rum is produced, but a pure potable alcohol is made in limited quantity. The recovery of aconitic acid has not hitherto been attempted on a commercial scale as in Louisiana. Filter mud is prized as a useful soil improver, and Natal cane famers meet the cost of loading and transporting it from the factories to their fields. A factory for the manufacture of paper products from bagasse has been erected.

Research and advice

The Natal sugar industry is in a leading position in regard to investigation and advisory services on agricultural and technical subjects. The experiment station at Mount Edgecombe, which is entirely financed by the South African Sugar Association, is well staffed and equipped to deal with all aspects of cane production, including plant breeding, testing, selection, propagation and distribution of new cane varieties; the study treatment and management of soils; pests and diseases and their control; and all related matters. The Sugar Milling Research Institute provides companion facilities for factory and process investigations. The cost of the institute's buildings, equipment, staff and operating charges is met jointly by the Council for Scientific and Industrial Research and the Natal Sugar Millers' Association. Problems of mechanisation of field operations are studies by a Mechanisation Working Committee, which has a staff and workshops for developing the design and construction of labour-saving agricultural equipment. An active Technologists'

Rolling fields of sugar cane grown near the sea

Association formed 27 years ago provides opportunities for the consideration and discussion of agricultural and technical subjects by planters, factory staffs and other interested persons. The *South African Sugar Journal* is a medium for the publication of matters of general interest and importance. This group of activities is well co-ordinated, and is highly valued by the industry.

The internal structure of the industry possesses elements of great interest, which have developed over the years to produce a well organised whole made up of distinctive components working in close co-ordination. Most of the cane is grown by independent farmers, the proportion of their production representing about 60% of the total. Similar systems prevail in Louisiana, in Queensland and elsewhere, though in Queensland farmers number about 8,000 and grow all the cane. The constitution and membership of the South African Cane Growers' Association differ in many important respects from those of cane farmer organisations in the West Indies, one of which is that small growers in Natal, who are all Bantus and Indians, are formed into separate associations. This avoids a serious disability for the cane farmers' association in Jamaica, which is weakened by the attempt which has been made to include all growers in one body irrespective of whether their annual production is 10 or 10,000 tons of cane. The provision of separate institutions for distinct classes of growers results in no loss of effectiveness, but rather adds to their strength because of the closer interests of their members.

In Natal there are 17 local planters' associations and mill groups which form the sub-divisional framework of the Cane Growers' Association on which all are represented. An important feature of the regulation and control exercised under the provisions of the Sugar Act of 1936 is that agreements entered into under specified conditions by growers and millers must have the prior approval of 90% of the growers who represent 90% of the total production by growers during the previous calendar year, and of millers who have manufactured not less than 90% of the total sugar produced during the same period.

Conclusion

This fascinating theme of contrasts and comparisons could be considerably amplified and extended, but sufficient has been recorded to bring out the principal points of similarity and difference with certain other countries, some of which have been engaged in sugar production for a much longer time than has Natal.

A New Fungicide

The Murphy Chemical Co. has recently announced that it has been appointed distributor for the United Kingdom and Ireland of a new fungicide produced by the California Spray Chemical Corp. of Richmond, California, U.S.A. Last month the company held a press conference and lunch at which the new product was described and its potentialities and action demonstrated by means of a film.

'Orthocide 50 Wettable'

The product is known and manufactured under the trade name of 'Orthocide 50 Wettable,' which is a wettable powder containing 50% captan. Captan is a new complex organic fungicide, its chemical composition is N trichloro methyl thio tetra hydro phthallimide and its empirical formula $C_9H_8O_2NSCl_3$.

It is reported to have given outstanding results for a number of important diseases of crops in the United States. Orthocide 50 Wettable is stated to be compatible with the majority of sprays in common use, except oil sprays or strongly alkaline materials such as Bordeaux mixture or strong lime sulphur wash. The rate of use is 2½ lb. per 100 gal. water, unless otherwise stated.

The preparation at recommended rates appears to be safe on a wide range of crops and, so far in this country, no susceptible varieties of plants have yet been found. It gives a better finish to leaf and fruit than the usual fungicides and, under U.S.A. conditions, the amount of russeting on apples is considerably reduced. When used as directed, the material can be regarded as non-poisonous to human beings, domestic animals and poultry, but it is injurious to fish. However, when handling the powder, care should be taken not to breathe it in as it may have an irritant effect.

For applescab and pearscab Orthocide 50 Wettable is considered to be as effective as lime sulphur as a protective fungicide and, in addition, while not as good an eradicant as a mercury spray, it definitely retards fungus growth and prevents spore development for a period of about 14 days. It is also reported to have given excellent results against Botrytis on strawberries, down mildew on hops, Phytophthera on outdoor tomatoes, Gloeosporium on stored apples and against Fusarium and Botrytis rots on bulbs and corms of flowering plants.

Supplies

Supplies of the fungicide are unfortunately not yet available in Europe, but it is hoped that they may become so in due course while plans for manufacturing the product in Europe are stated to be under active consideration.

The Cocoa Industry in Nigeria, the British Cameroons and the French Cameroons

Part 2—The British Cameroons

D. H. URQUHART, B.Sc. and G. A. ROSS WOOD, B.Sc.

Cadbury Brothers Ltd.

This is the second in the series of articles on cocoa in West Africa, based upon the two authors' recent tour. It deals with conditions in a little known part of Africa, and indicates that in this region conditions are well suited to development under cocoa. We are indebted to Cadbury Brothers, Ltd., for permission to reproduce it.

THE Trust Territory of the British Cameroons consists of the Northern Cameroons and the southern areas, the total area of which is estimated at 34,081 sq. miles, with a population in 1951 of 1,083,800 people. The greater part of the forest zone lies within the Cameroons Province, and it is within this province that the conditions suitable for cocoa are to be found.

The Cameroons Province consists of three divisions, namely:

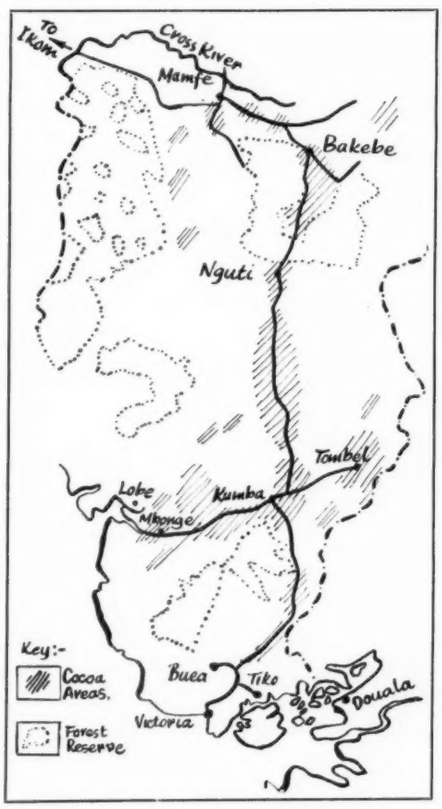
Division	*Area in sq. miles*	*Population*
Mamfe	4,321	70,000
Kumba	4,162	76,000
Victoria	1,166	52,000

The exportable products are bananas, cocoa, rubber and palm kernels. In 1951 the amount of cocoa exported was 2,320 tons valued at £646,200. Cocoa is the only important crop grown for export by the peasant farmers, apart from a small fresh banana industry which has recently been developed for the farmers in Victoria Division. The other export crops are bananas and rubber from plantations and palm kernels from plantations and natural palmeries. All the cocoa exported, with the exception of about 80 tons which comes from C.D.C. estates, is produced on peasant farms.

Economics of cocoa and other export crops

Cocoa with its assured market at a good price seems to be the best crop for raising the revenue and increasing the prosperity of the Cameroons. It grows well and, apart from a high incidence of black pod, which can be controlled, it is freer from disease here than in most other parts of the world where it is grown. It is easily stored and transported. It is significant that in 1951 the value of 2,320 tons of cocoa exported was £646,200 and 72,960 tons of bananas was £2,200,300. A simple calculation will show that had the export of cocoa been 7,900 tons in 1951, its export value would have been equal to that of the banana crop. A study of the exports for the same year shows that export of 2,360 tons of cocoa almost equalled in value the total value of 240 tons of dried bananas, 1,236 tons of palm kernels and 1,420 tons of rubber.

If production could be stepped up to 16,000 tons, a target which is achievable within a few years, this would enable the Cameroons to double the value of its exports. In 1951, the total value of all exports, including re-exports, was £3,778,200, equal to the value of 13,560 tons of cocoa at the price ruling in that year. Should there be any doubt about the practicability of increasing production, reference to the achievement by the French, not many miles away, under conditions in no way more favourable than those which obtain in the British Cameroons, will be convincing. In the French Cameroons production has been stepped up from 29,000 tons in 1941-42 to 55,000 tons in 1951-52. The target set by the French authorities is to reap 120,000 tons from the land already planted in cocoa, apart from what may be derived from further planting.



British Cameroons, showing cocoa-growing areas

Communications

The provision of more and better roads is most important for the development of this territory. The present main road system from the ports inland and connecting up main centres is shown in Table 1.

The two main ports are Victoria and Tiko; produce from Mamfe is exported mainly down the Cross River during the 2½ months when it is in flood. Produce is also exported from Mbonge and Ndian to Calabar and the C.D.C. send fresh bananas from their Tombel Estate via the French railway from Lum to Bonaberi when the River Mungo is too low for barges. The C.D.C. transport the produce from their estates down the Mungo River to Tiko,

TABLE I

Road	*Miles*	*Remarks*
Victoria-Kumba ..	65	Being improved and will soon be a first-class road.
Kumba-Mamfe ..	120	Being improved and will be a good road in two years' time.
Kumba-Mbonge ..	32	Extremely rough.
Kumba-Tombel ..	25	Impassable at the present time.
Mamfe-Ikom (Nigeria)	60	Extremely rough, and is hazardous in the wet season. Bridge being built over the Cross River to replace ferry.
Mamfe-Calabar ..	155	In process of construction.
Ikom-Enugu	140	The first 40 miles from Ikom extremely rough, and two ferries to cross.

when there is sufficient water to carry the barges.

The present relatively backward state of the British Cameroons is mainly due to lack of roads. The existing roads, with few exceptions, are extremely rough and destructive to all forms of transport which have to use them. Gradients are steep and hazardous, and the bridges in some of the main roads are so weak that lorries have to unload before crossing. Road-making, in many parts of the Cameroons, presents more difficulties than in other parts of West Africa. The volcanic soil makes a poor surface which becomes a quagmire under traffic in the heavy and prolonged rains of the wet season. The only roads which can stand up to these difficult conditions are good roads made at considerable expense. The authorities concerned are facing up to this fact and are employing contractors to rebuild the Victoria-Mamfe road. Similar steps to improve the Kumba-Mbonge and the Kumba-Tombel roads are much needed.

A glance at the map illustrating the development of cocoa planting in the Cameroons shows clearly that where roads have been made planting has taken place. It can safely be assumed that where roads are made, to provide access to other productive areas, rapid developments on similar lines would take place.

Soils and scope for further planting

Most of the soils on which cocoa is now growing are suitable for the crop. There are extensive areas of good soil still unplanted both in Kumba and Mamfe Divisions. The population of these two divisions represents a density of 18 and 16 per sq. mile respectively, and even after allowance has been made for areas of mountain and swamp which are uncultivable, and land for food crops and other purposes, the scope for expansion within the capacity of the available population is almost unlimited.

History of cocoa planting

Cocoa was introduced by the Germans as far back as 1892; they made introductions subsequently from South America, the West Indies and from San Thomé during the following 13 years. The introductions were planted in the Botanic Gardens and some of them were chosen later for planting on estates. By 1912 production had reached 3,392 tons. It was not until much later that the local farmers took an interest in the crop, but in due course production by estates became less and, of recent years, nearly all the cocoa has come from African-owned farms.

Suitability of the climate

The rainfall is heavier and spread over a greater period than is the case where cocoa is grown with success in Nigeria and the Gold Coast. This has advantages and disadvantages. The advantages are that the rainfall is adequate in nearly all parts of the cocoa areas and the cocoa trees yield over a longer period than is the case elsewhere in West Africa. The disadvantages are that overclouded skies and the humid conditions associated with heavy and prolonged rainfall, particularly at the higher altitudes, are conducive to a high incidence of fungoid diseases, especially *Phytophthora* which gives rise to black pod. As much of the cocoa ripens during the wet months, June to October, it is necessary to resort to artificial drying of the fermented beans.

Weighing up the advantages and disadvantages, it can be said that the climate of the Cameroons is excellent for cocoa because it promotes the rapid and healthy growth of the trees; the high rainfall enables the trees to give a maximum yield and there is no reduction of crop or size of bean due to droughts as is the case in other parts of West Africa. There are cheap and economic means for artificial drying and there are good prospects that economic methods can be applied to the control of black pod.

Type of cocoa grown

Probably many of the original introductions were hybrids and not pure strains, and the cocoa now grown is the result of the crossing of the various introductions. Where cocoa is grown in suitable soil with adequate shade and not mutilated by unskilful pruning, it develops into robust trees with strong stems and branches and luxuriant foliage. The beans are mostly of good size, better generally than is to be found in most parts of Nigeria.

Possibly due to the fact that a careful study has never been made of crop yields

(*Left*) An example of a cocoa tree with leafless twig (*Right*) Rejuvenation of old cocoa by raising chupons from the base of the tree. Department of Agriculture plot near Kumba

in the Cameroons, and the fact that African farms are usually neglected or unskilfully tended, and often only partially harvested, it has been accepted that the cocoa trees now growing in the Cameroons are inherently poor yielders. Recent experience indicates, however, that these trees are capable of giving very high yields. An African farm, at Kake, near Kumba, chosen for spraying experiments, and of which pod yields were recorded, had a number of trees giving over 200 pods per tree in 12 months. The average was 66 pods per tree in 12 months for the whole plot. In the French Cameroons, where

Cocoa trees bearing good crop, British Cameroons

the cocoa is derived from the same source as that of the British Cameroons, a selected tree has given an annual yield of 13 lb. of dry cocoa. Casual observation of trees in bearing on African farms, and on the C.D.C. estate at Tombel, suggests that there are many trees with the capacity for high yields.

Cultural methods

African cocoa farms are established from seed and usually spaced about 12 ft. apart. There is a tradition that the trees grow better in absence of shade and that severe pruning is necessary. These theories were probably evolved in German times when it was maintained that it was necessary to 'let the light into the tree' to avoid high losses through black pod. Whatever may be the effects on black pod of letting the light into the tree the net results of no

Heavy crop of cocoa pods just harvested on a peasant farm at Tombel

shading are extremely unfavourable to the growth of the tree. Its exposure to the untempered rays of the sun results in leafless twigs where the development of the growing tips of the branches is arrested. This, together with damage done to the tree through excessive pruning, reduces the capacity of the tree to produce pods to a low level.

There is no doubt that cocoa everywhere from Ikom, in Nigeria, to the French Cameroons, grows best under shade. The combination of shade and spraying for fungus control will certainly give the best results.

It seems possible that the strain of cocoa evolved from the various introductions is particularly susceptible to exposure to the sun. Nevertheless, it grows well in the Cameroons climate, and can give high yields. It is extremely doubtful if the Amelonado strains which have performed well in the much lower rainfalls elsewhere in West Africa would grow equally well in the climate of the Cameroons.

Diseases and pests

Black pod. There are heavy losses from this fungus. Experiments by the Department of Agriculture show that it is economic to control the fungus by spraying.

Capsids. There is little evidence of damage by this pest, although capsids are liable to attack young seedlings where these are grown in absence of shade.

Thrips. These cause some damage in the dry season.

Thread blights. These are common in Mamfe and are to be seen further south.

'*Mistletoes*' (*Loranthus sp.*). Very common and do much damage to the trees. The local farmers are not particularly industrious in removing them.

'*Leafless twig.*' Where trees are unshaded they develop small leaves on the tips of the branches and the trees have a debilitated appearance. The condition does not seem to be associated with disease, but is due to the inability of the plant to stand exposure. Where trees are shaded, this condition is absent.

Vein-clearing of the leaves. A vein-clearing of the leaf occurs which in some respects resembles the condition of the leaf when infected with certain strains of virus. Investigation has shown that there is no virus present, and it is thought that the condition may be due to absence of some trace element, or similar cause. It has no deleterious effect on the cocoa trees.

Fermentation, drying and quality of the finished product

The proportion of fermented beans is probably higher than elsewhere in West Africa. The question of finding a satisfactory method of artificial drying which would suit the farmer has always been a difficult problem. The Department of Agriculture has evolved a cheap and simple drying house which has given satisfactory results, and which should have a wide appeal to peasant farmers and to co-operative societies.

Cocoa from the British Cameroons has suffered in popularity from the fact that parcels of smoky, hammy beans have come

Cocoa beans drying in the sun on a peasant farm at Tombel. The Department of Agriculture is encouraging farmers to raise their drying trays off the ground

from here in the past. A careful study of conditions of preparation and storage of cocoa in the territory makes it clear that the smoky taint is acquired when cocoa is stored in the dwelling houses where it comes in contact with smoke from the fire. The Department of Agriculture have the matter in hand, and they are confident that this unpleasant reputation will no longer apply to the cocoa of the Cameroons.

The Cameroons Development Corporation

This corporation was set up as the result of legislation passed by the Nigerian Legislature in December 1946 for the purpose of administering the ex-enemy lands. Under the terms of Ex-Enemy Lands (Cameroons) Ordinance, No. 38, of 1946, the lands were declared to be native lands and to be held by the Governor for the use and common benefit of the inhabitants of the territory. The ordinance states that ' after providing for all necessary financial contingencies and the setting up of appropriate general or special reserves the remainder of the annual profits of the Corporation are required to be applied to the benefit of inhabitants of the Cameroons under British mandate in such a manner as the Government may determine.' A body of seven members under the chairmanship of Mr. A. H. Young, C.B.E., is responsible for the affairs of the Corporation.

The Corporation, with many estates which grow bananas, rubber and oil palms —a total of 57,756 acres being under these crops—together with various other valuable assets, is a factor of the greatest importance in the economy of the territory. Apart from the funds it provides for development schemes, the lead shown by the Corporation in planting various crops, and the standards of husbandry set by it, will have enormous influence on the peasant farmers. A number of specialist staff are employed, and plans are in train to set up a research unit to study the needs of the crops. This is a progressive measure which it is hoped may eventually be to the benefit of the territory as a whole, as many of the problems requiring specialist skill are neglected due to the difficulty of sending specialists from Nigeria to work in the Cameroons.

Rightly or wrongly, the Corporation have developed bananas, rubber and oil palms and neglected the development of cocoa in the past. It has, however, now been decided that attention will be given to cocoa. A start has been made with Tombel estate which has an excellent rich soil and is admirably suited to the crop. Cocoa grows well in peasant farms in this locality. There are about 1,100 acres of old and neglected cocoa now growing on the estate, and the intention is to shade and rejuvenate this cocoa and plant cocoa anew in another part of the estate.

Company development

Pamol Ltd.—a subsidiary company of Unilever—is developing a large estate in the Western Cameroons, at Lobe, near Mbonge. It is being planted mainly with bananas, but an area of cocoa is also to be planted. A further area is to be planted on the company's estate at Bai in the same locality.

The standard of peasant cocoa farms in this region is low, and there are no estates growing cocoa. The decision of Pamol Ltd. to grow cocoa is a matter of great importance. The company applies high standards of skill and efficiency on its plantations, and the example set by them should have far-reaching influence on peasant practice in due course.

Possibilities for cocoa in the Cameroons

It is no exaggeration to say that the Cameroons could produce ten times its present production without any great effort. It could within a couple of decades become one of the important cocoa producers in the world. It has all the advantages of great areas of excellent soils, a favourable climate, a people who like to plant cocoa, and some excellent cocoa material already on hand.

The fact that production from African farms has not shown any steady expansion need not be regarded with undue pessimism. Until within the last few years, the interest taken in the industry was limited to guidance in fermenting and drying and the formation of co-operative societies for selling the cocoa. There are now two senior officers of the Agricultural Department stationed at Kumba with cocoa as their main concern. No doubt the adequate staffing of the Department is a matter which will receive attention. Already it has demonstrated the possibilities of black pod control by spraying, and has various experiments and demonstrations in train for the improvement of cultural methods and preparation of cocoa. The laying out of a cocoa estate east of the Kumba-Mamfe road is under consideration for the purpose, among other things, of demonstrating enlightened methods of cocoa culture.

The fact that the Cameroons Development Corporation are to grow cocoa on their estate at Tombel, and Pamol Ltd. are to grow some cocoa on their estates at Lobe and Bai, will give a lead to African farmers which has been previously lacking.

Conclusion

Factors which contributed to a low output in the past are:

(1) Unskilful treatment of the trees by over-pruning.

(2) Unfavourable conditions created on cocoa farms through lack of shade.

(3) High incidence of black pod due to lack of any form of control of this disease.

(4) Vacant stands on cocoa farms where trees have died out, and presence of trees which are senile as the result of unskilful treatment.

(5) Crop is only partially harvested, many of the pods remaining on the trees from one season to another, and the incidence of black pod is thereby increased.

(6) Lack of keen competition in buying cocoa from the farmers and delay in making payment for cocoa bought, has discouraged cocoa growers.

(7) Lack of good main roads and roads to many important cocoa-producing areas.

All these drawbacks can be remedied. The Department of Agriculture officers are carrying out experiments in better methods of cocoa culture, demonstrating methods of fungus control by spraying, rejuvenation of old trees by means of chupons, and better attention to the farms generally. Keener competition in buying will make for more efficient harvesting. Provision of more and better roads will result in better exploitation of areas already planted and lead to further planting. There are some very heavy bearing trees in the farms of the Cameroons, and selection of the best of these might profitably be given priority over the introduction of new material.

Pea Blight Danger

The English Ministry of Agriculture has discussed with representatives of the National Farmers' Union, the Home-Grown Threshed Peas Joint Committee and the Seed Trade Association the possible danger of the above disease being introduced into Britain by seed imports from abroad.

No imminent danger

It is understood that the majority of the country's seed pea imports are from countries where the disease is not established, and in such cases there is no risk of the imported seed being infected. There is no authentic record of the disease in the United Kingdom. On balance, therefore, there seems to be no imminent danger of the disease becoming established. The Ministry is, however, at present engaged in the revision of its Importation of Plants Orders and in doing so will consider the necessity of taking steps to ensure that only disease-free seed is imported into this country.

Australian Farming News

(*From our own Correspondent*)

Rice harvest

A record rice harvest is expected in the Murray Valley area in 1954, according to the chairman of Water Holdings Ltd., speaking at the annual meeting in Melbourne. Echuca Rice Milling Pty. Ltd., in which the company holds a substantial interest, should have another good year, he said. Northern Development Pty. Ltd., which operates the experimental rice project in the West Kimberley district, has had limited success with a trial planting last year, producing sufficient rice seed for further small experimental plantings. Operations in the current year should reveal whether rice could be grown commercially in the area. Good seasonal rains had fallen.

Agricultural services

The general executive of the Farmers' Union recently considered the need for increased agricultural services. It emphasised the shortage of funds for work of such great importance. The executive decided to urge the Government to increase the amount of the agricultural vote. The general secretary, Mr. A. G. Traine, says it was also decided to ask the Government to lift the status of the Department of Agriculture, so that it would be more in keeping with the importance of agriculture to the State. The producer-representative on the Agriculture Protection Board, Mr. W. Huxley, says that to assist in the eradication of rabbits, the board has supplied 14 local authorities with light rippers to deal with warrens. Good results had been achieved by these. Concern at the uncontrolled clearing of land was expressed during a discussion of soil conservation. Fear was expressed of wind and water erosion as a result of total clearing without supervision and planning.

Agricultural outlook

There have been striking changes in both the long- and short-term outlook for Australian agriculture during the last three years; there is an upward trend in production which should continue, though not at the rate which public speculation has prompted many to expect. The National Security Resources Board reaches this conclusion in its report on the agricultural situation for the three years 1950-53. The board notes that primary industries in the early post-war years were in bad condition and needed the opportunity for rehabilitation and expansion. Their problem was one of manpower, materials and equipment. Post-war shortages persisted for a long time and there was a general feeling of frustration among primary producers. That situation, the board says, has changed, and it would be quite reasonable now to expect a significant upward trend in total production, although some critical factors require serious attention.

The report points out that on the side of prices the picture is more uneven. Although for the major share of exports the price situation is good, for commodities bringing in about one-sixth of primary export income, and including dairy produce and processed food, the price experience is less happy and points to an emerging problem of some importance, namely, high costs in certain export industries.

Production

'Commonwealth and State Governments,' the survey states, 'have combined in an attack on the problems of the farmer. Agricultural production has been given top priority in development programmes as an aid to defence. Production targets have been set. Taxation on farm income has been modified so as to encourage improvements and the building of homes for farm workers. Imports of needed machinery have been encouraged and local production of machinery and materials and fertiliser fostered.' Investigations by the C.S.I.R.O. into the correction of soil deficiencies have given means of establishing exotic grasses, clovers and other legumes over some 10 million to 15 million acres in South Australia, Victoria and New South Wales. Preliminary results of similar work in Queensland give promise of comparable development over some millions of acres in the well-watered central and south coast of that State. An overall trebling of the carrying capacity may be brought about eventually, and in many cases this may well be exceeded. In the upper south-east of South Australia the potential increase in carrying capacity is at least ten or twentyfold more than that obtained under natural vegetation, and in the New England region of New South Wales, pastures which previously maintained one sheep or less per acre have maintained from six to eight sheep throughout the year. There is no doubt that as a result of the continuation of studies so far undertaken the present area of sown pasture of perhaps 22 million acres can reach eventually 100 million acres in southern Australia and coastal and sub-coastal Queensland.

The Toxicity Hazard of Aldrin, Dieldrin and Other Chlorinated Hydrocarbon Insecticides

FRANK PRINCI, M.D., F.A.C.P.

University of Cincinnatti, U.S.A.

Articles dealing with the toxic hazards attaching to the use of insecticides have appeared in WORLD CROPS *previously. The article below discusses this question from the point of view of American medical science in relation to the chlorinated insecticides and specifically Aldrin and Dieldrin. The author, Dr. Frank Princi, is Associate Professor of Industrial Medicine in the University of Cincinnatti.*

AS more effective chemicals for the destruction of insects have been developed and used, the question of the effect of these substances upon human health has become of great importance. Since this field has developed so rapidly in the last two decades, it is not surprising that research investigators have been overwhelmed by the task of assessing the toxicity of these materials and that much confusion has, and continues, to exist. Unfortunately, therefore, in too many instances, the lack of publication of factual data has resulted in the substitution of opinion for scientific knowledge.

Opinion and knowledge

Although the origin of such opinions may be obscure and based entirely on hearsay, all too often this information becomes public and is looked upon as official. In such cases total lack of perspective develops and precautionary statements are issued which may have no relationship whatsoever to the actual use of a material.

So common have been these unofficial opinions and so widespread in their effectiveness in influencing public opinion that Dr. Maurice H. Seevers, chairman of the section on experimental medicine and therapeutics of the American Medical Association, was prompted to say, at the 102nd annual meeting of the American Medical Association: ' In order to effect such legislation an " impartial " committee of the House of Representatives to investigate the use of chemicals in food products was impanelled to hold hearings on the problem. In the midst of these hearings, the chairman, James P. Delaney of New York, published an article in the June 1951 issue of the *American Magazine*. This lurid article, a masterpiece of innuendo and fantasy based principally on conjecture, was designed for the one purpose of frightening the housewife into demanding further legislation.' Under such circumstances it is not surprising that new materials, recommended for insecticidal use, are subject to suspicion, fear and misunderstanding.

Research in toxicologic problems

If scientific research on toxicologic problems was merely a matter of exposing animals or groups of animals to varying quantities of the material and, at autopsy, determining the pathologic changes in the tissues, evaluation of the findings would be relatively simple. Unfortunately, however, toxicology is also a matter of (1) metabolism and elimination, (2) the time, frequency and mode of administration of the material and, above all, (3) of the quantity administered within definite periods of time. Many materials which are harmful within certain limits of dosage are either harmless or, in some instances, actually useful and indispensable when taken into the body in appropriate quantities. Moreover, many poisons turn out to be useful agents for the cure of disease under proper conditions of use.

The environmental hazard

In any consideration of the environmental hazard which may be present during the use of a chemical, certain fundamentals of toxicity apply, regardless of the nature of the chemical, mode of manufacture and method of use. The words ' toxic ' and ' toxicity,' by themselves, seem to produce the greatest amount of confusion and misunderstanding. To say that a material is toxic signifies merely that it is potentially capable of producing deleterious physiologic effects. Since it bears no relationship to dose or likelihood of action, ' toxic ' is a term which may be applied to any material because any substance may adversely affect the human organism if it is given in sufficiently large quantities. Thus, *per se*, this term does not delineate the possible harm that can be anticipated, without consideration of other factors which are necessary to produce an effective physiologic response.

' Exposure ' indicates that the individual is in the vicinity of, or is exposed to, a toxic material, but this term, like ' toxicity,' bears no relationship, by itself, to the probability or likelihood of intoxication. The word ' hazard ' implies that the toxic material exists in quantities which are likely to produce adverse effects if the substance is absorbed. No effect will transpire, however, unless a certain amount of absorption occurs. Finally, therefore, absorption of adequate quantities of any toxic material must take place, regardless of the hazard and the exposure, before deleterious physiological reactions will occur.

Any of the organic insecticides can be absorbed, either by swallowing, by prolonged contact with the intact skin or by inhalation and absorption through the respiratory tract. In any exposure differences will occur in rapidity of absorption, and these differences will be dependent upon the physical form of the material concerned. For instance, the organic insecticides are more readily absorbed when they are in the forms of sprays or emulsions and they are less rapidly absorbed when they are in the forms of dusts or powders. From the practical point of view the gastro-intestinal tract offers the most rapid route of absorption. Absorption is somewhat less rapidly effected through the respiratory tract and, perhaps, least rapidly through the skin. Regardless of the relative absorption, however, adequate

quantities of absorbed material will produce rather prompt physiologic responses and these will be manifested in general by similar types of symptoms. The only exception to this broad rule is that ingestion of the material will result in rather prompt and violent emesis, whereas absorption by other routes is less likely to produce vomiting.

Chlorinated hydrocarbon insecticides

The precautions for the use of any of the chlorinated hydrocarbon insecticides are the same. It is unrealistic to suggest that certain precautions are necessary with one of these materials whereas the same precautions are not necessary with others. All of the chlorinated hydrocarbon insecticides are mixed and applied in a large variety of formulations. Mixing takes place on a large scale in formulating plants and, in these establishments, concentrations of the technical material can be expected to be relatively high. Therefore, in addition to good housekeeping, these areas should have adequate ventilation, proper washing facilities and proper supervision to assure that the necessary simple precautions are observed.

Essential precautions

Care must be exercised to prevent unnecessary agitation of the materials and spillage of any of the compounds or concentrates which are being formulated. Where mixing is done in large quantities, positive exhaust ventilation should be employed. If the materials are being mixed in small quantities and/or if significant quantities of such materials are dispersed into the working atmosphere, respirators with suitable filters should be used.

Other ordinary precautions include the use of clean clothes daily and general personal cleanliness. The hands should be washed before smoking and eating, and showers should be taken before changing into street clothes. If liquid mixtures of the material are spilled on the clothing, clean garments should be put on as soon as possible. In case of any spillage of material on the skin, ordinary washing with soap and water is adequate. Protective gloves should always be worn during mixing operations where there is any likelihood of concentrates contacting the hands.

Ground and airplane spraying

In ground spraying all the ordinary precautions of cleanliness described above should be maintained. In addition, care must be exercised to avoid direct contamination of other workers by spraying occupied areas or machinery. Spray rigs which are properly designed and operated offer no hazard.

Aeroplane spraying provides special problems in addition to maintaining proper personal hygiene. Insecticide tanks should be checked at frequent intervals to guard against leaks. Spillage should be cleaned up promptly, even if time is lost in the process. Pilots should not fly through a swath of dust or spray which has just been laid down and which has not settled. In addition, ordinary and reasonable care should be taken to avoid application of insecticides by aircraft when the pilot is fatigued, ill or not alert for any reason. Finally, the observance of the ordinary rules of cleanliness and common sense, of themselves, provide the best safeguard against this type of environmental hazard.

Aldrin and Dieldrin

Of the several different chlorinated hydrocarbon insecticides in widespread commercial use, aldrin and dieldrin may be considered to be the most potent insecticidally. Aldrin's insecticidal activity is illustrated by the fact that as little as 2 oz. per acre is sufficient for effective grasshopper and locust control. When used for mosquito control, dieldrin is often recommended at one-eighth the dosage of DDT. Since it is reasonable to expect that increased insecticidal potency will be paralleled by increased biological effects on mammals, aldrin and dieldrin have been suspected of presenting greater hazards of use. However, this suspicion is not substantiated by evaluation of potential hazard on the basis of end-use concentrations of individual insecticides or by use experience.

During the early phases of development of aldrin and dieldrin, therefore, many restrictions were imposed and many precautions were adopted which have since proved to be exaggerated and, in most instances, unnecessary. In fact, after many years, of intensive use and after the dissemination of several million pounds of these materials, it is now known that the relative hazard of the use of aldrin and dieldrin is no greater than that which is found in the use of other chlorinated hydrocarbon insecticides. Unfortunately, however, because of the care that was exercised in the early use of these substances, there continues to be much unwarranted apprehension concerning the actual potential hazard in their use.

Toxicity

Continuous studies of workers who have been engaged in the manufacture, formulation and use of aldrin and dieldrin for more than four years has shown that safe handling is possible and that continuous exposure has not resulted in deleterious effects when observing only the precautions normally employed with the other chlorinated insecticides. During the period of these studies many millions of pounds of these materials have been produced and distributed in nearly all parts of the world. Harmful physiological effects were revealed only in those instances where excessive absorption has occurred, either by reason of accidental or intentional ingestion or by unusually careless handling. A study of the pertinent medical records provides information which aids in the understanding of the hazards of these materials during normal use. These studies also provide knowledge concerning the results which have occurred during periods of gross carelessness in handling and in situations of extremely high exposure.

Thus, when illness has developed because of ingestion of such materials as aldrin and dieldrin, symptoms of irritability, headache, loss of appetite, loss of weight and insomnia have developed. These symptoms almost never come on suddenly unless extremely large amounts are taken orally. What is most significant, however, is the fact that when the exposure is terminated, recovery is prompt and complete. No sequelae appear and chronic illnesses have not developed. In those instances where recovery does not take place following exposure to a chlorinated hydrocarbon insecticide, one should suspect that the chemical was not responsible for the injury and, perhaps, that another disease entity exists. Clinical investigations have now been carried to a sufficient degree to make it evident that this statement is correct. There are no factual data to indicate the opposite.

Fallacies concerning hazards attending their use

If aldrin and dieldrin present no greater hazard than any of the other chlorinated hydrocarbon insecticides, why is there so much alarm and fear concerning their use? For example, it has been said that aldrin and dieldrin are 20 to 30 times more toxic to people than DDT. If this were true the experience of use and misuse over many years and in many areas would have produced a large number of cases of intoxication. Since continuous and careful investigation have not revealed any significant number of illnesses and no cases whatsoever of mortality, it is well to examine the data upon which these opinions are based.

In the field of toxicology it has been customary to compare insecticides in terms of their relative toxicity as compared with DDT, since this compound is considered to be the most innocuous of the chlorinated

TABLE 1
COMPARISON OF CHRONIC ORAL TOXICITY PER UNIT SURFACE OF VARIOUS PUBLIC HEALTH AND HOUSEHOLD INSECTICIDES
(Experimental findings as related to actual quantities used)

Insecticide	*Acute oral toxicity (rats) (LD-50 in mg./kg.)*	*Chronic oral toxicity (rats) (p.p.m. in daily diet)*	*Chronic toxicity ratio with DDT as the unit*	*Common dosage for public health use (mg./sq. ft.)*	*Dosage ratio with DDT as unit*	*Relative chronic toxicity per unit area**
Aldrin ..	50	25	2	50	0.25	0.5
Dieldrin ..	65	25	2	25	0.125	0.25
Compound B	500	25	2	100	0.5	1
DDT ..	250	50	1	200	1	1
Compound E	>6,000	100	0.5	200	1	0.5
Compound G	125	50	1	50	0.25	0.25

*Equals toxicity ratio multiplied by dosage ratio.

TABLE 2
COMPARISON OF CHRONIC DERMAL TOXICITY PER UNIT SURFACE OF VARIOUS PUBLIC HEALTH AND HOUSEHOLD INSECTICIDES
(Experimental findings as related to actual quantities used)

Insecticide	*Subacute dermal toxicity (rabbits) (mg./kg.)*	*Chronic toxicity ratio with DDT as the unit*	*Common dosage for public health use (mg./sq. ft.)*	*Dosage ratio with DDT as the unit*	*Relative chronic toxicity per unit area**
Aldrin	20	7.5	50	0.25	1.9
Dieldrin	40	3.8	25	0.125	0.5
Compound B ..	30	5	100	0.5	2.5
DDT	150	1	200	1	1
Compound E ..	600	0.25	200	1	0.25
Compound G ..	40	3.8	50	0.25	1

*Equals toxicity ratio multiplied by dosage ratio.

hydrocarbon insecticides. Consequently, comparisons of LD-50 values for animals have been used extensively to indicate relative toxicity. By definition, the LD-50 merely signifies the dose which will kill 50% of the exposed animals. It bears no relationship to the amount to which humans are likely to be exposed or are likely to absorb. However, if one takes into consideration the common use of these materials and calculates their relative toxicity in terms of application rate and dosage, it becomes evident that during actual use aldrin and dieldrin are less toxic than the absolute LD-50 figures for animals would indicate. For example, Table 1 shows that in the control of household and public health pests, aldrin is one-half and dieldrin is one-fourth as hazardous by chronic oral ingestion as is DDT. Table 2 indicates that when skin contact is involved, aldrin is approximately two times as toxic as DDT and dieldrin is one-half as toxic.

From the practical point of view, however, a review of actual experiences in the field is of interest. Such a review indicates not only whether or not theoretical considerations are correct but, in addition, provides adequate evidence of what occurs even when minimum precautions are taken. In Mexico, thousands of acres have been sprayed and dusted with aldrin and dieldrin compounds during the past three years. In this area the peons apply the insecticide with anything from a porous cloth sack or can with holes of shaker type to a commercial type knapsack duster. No protective clothing is used and, usually, the peons will go barefoot or, even, in shorts while applying the material. Approximately 40% of the insecticides used are applied by Mexicans in this fashion. Despite this fact there have been no reports of intoxication of any degree with aldrin or dieldrin in that country.

Some examples

In the southern part of the United States (despite the precautions which have been recommended), no protective clothing or gloves are used by many persons handling insecticides. In many instances no shoes or hats are worn by the applicators. Even where there has been poor ventilation, dust accumulation, lack of clean clothing, lack of shower facilities and of any other type of personal protection no reports have been received of any sickness or injury which was correctly attributed to the formulation and use of aldrin or dieldrin products. This is remarkable because careful attention has been paid to these areas and every complaint has been investigated immediately by competent medical people.

In the State of Illinois, where approximately 30,000 acres were sprayed with dieldrin at the rate of ½ lb. per acre, a questionnaire was sent out to determine the incidence of difficulty or complaints. There were no reports of any actual deleterious effect on the health of any of the individuals who applied or worked with the material.

In one South American country a group of public health workers applied 5% dieldrin dust to the bodies of a large number of schoolchildren in an attempt to reduce body lice. Severe and unnecessary as this application may be it is significant to note that even in the case of children no harmful results were reported. Similar reports have been obtained from areas where the material has been mixed, due to ignorance or lack of experience, by immersion of the hand directly in the spray solution. Again no intoxications were found.

Conclusions

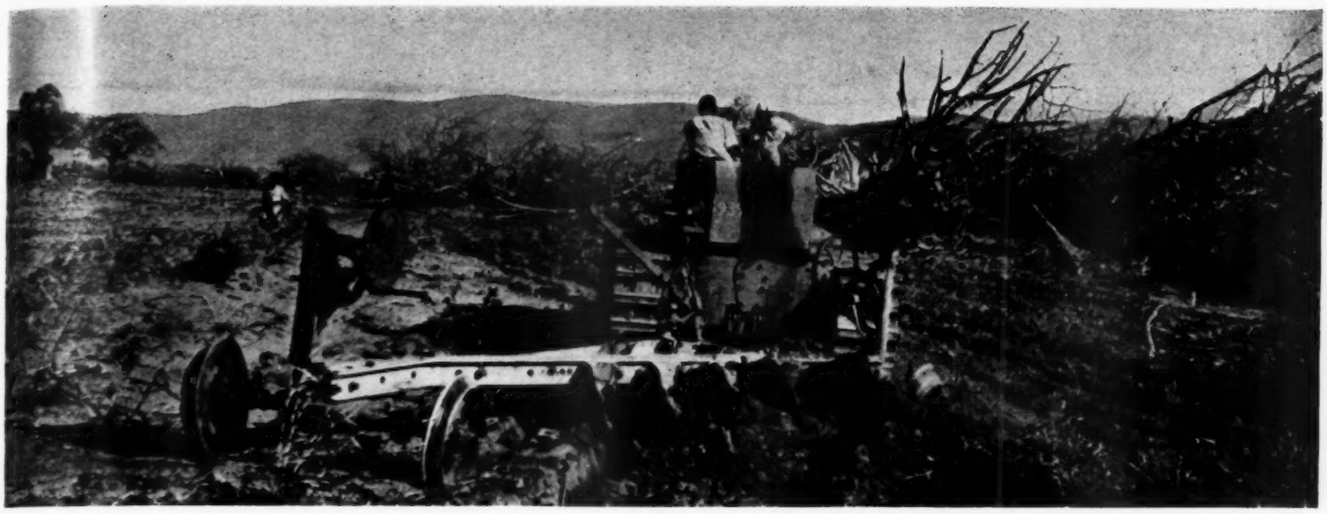
The foregoing is by no means a recommendation that any of the chlorinated hydrocarbon insecticides should be employed carelessly. But, since there is no substitute for the human experience gained by use of any material in the field, these data indicate that the hazard involved in the practical use of all of the chlorinated hydrocarbon insecticides is probably about equal. However, regardless of the potential hazard of any of them, they should all be handled and applied with respect.

In conclusion, the fact that one material is more potent than another in killing insects does not necessarily prove that it presents a greater use hazard. In fact, the more effective material may frequently be used in such small quantities that it is less hazardous in use than one which must be used in greater concentrations or with higher dosages.

A New Agricultural Research Institute in Czechoslovakia

The scanty news that penetrates from countries behind the Iron Curtain is always of interest and we learn that a new research institute designed to achieve improvements in agriculture and forestry commenced work in Czechoslovakia on April 1 last. It is a part of the National Academy of Agricultural Science and among its tasks is the study of the effects on soil of shelter belts of trees as well as the effect of irrigation on the production of various agricultural products.

The new organisation supplements the work of the previously existing experimental station at Borkovice in Southern Bohemia, the main activities of which have been concerned with the reclaiming for agriculture of peat bogs and the cultivation of potatoes on the reclaimed areas which, it is claimed, has given remarkable results.



Heavy disc ploughing being carried out on recently cleared land

The Mechanical Clearing of Forest and Scrub Land

OF recent years interest has been increasing in the mechanical clearing of bush and forest land, both in the United Kingdom and overseas. The main reason for this has been the steadily rising costs of agricultural labour all over the world which has caused attention to be turned to methods of clearing land mechanically which can replace wholly or in part operations which were formerly performed by manual labour.

Interest has been heightened by the demand for additional land which is arising in many parts of the world like the United Kingdom, where pressure of population and the need for producing as large a proportion as possible of the national food requirements from local sources in place of relying on imported supplies from other lands has stimulated interest in the utilisation of non-productive areas. On the latter account much attention is being paid to the reclamation for agriculture of areas of overgrown land which have for one reason or another become derelict.

Possible methods

In the clearing and reclamation of lands of this type a number of methods are capable of being used. These may include the use of machines such as mechanical cutters which cut through the vegetation to be cleared, devices such as bulldozers or angledozers which push over and uproot the vegetation, methods such as chain clearing which pull vegetation over and uproot it, grabs operated by hand or mechanically which extract roots and stumps from the soil. Then again there is the use of explosives to blast out of the ground intractable roots, while a recent development is the increasing use of chemicals which destroy vegetation and enable it to be burnt out after it has become dead and dry. A special problem is the elimination of the mass of tangled roots with which ground is usually encumbered after the taller growth has been removed.

Varying aspects

It is to be noticed that the problem of clearing land may present very varying aspects according to the conditions of soil, climate and vegetation which prevail at the point of operation. In the tropics clearing operations may present very differing aspects from what they do in temperate countries. Moreover clearing in the humid tropics may differ considerably from clearing, say in the miombo bush of parts of East Africa where annual rains are comparatively light. So far as is known attempts at mechanised land clearing under tropical conditions have so far been confined to the areas of lower rainfall.

Experience in Africa

At a meeting in April last of the Agriculture Group of the Society of Chemical Industry a series of papers was read dealing with various aspects of land clearing in the drier parts of tropical Africa. The first of these was by Dr. A. H. Bunting who, it will be remembered, contributed a paper on the same subject to WORLD CROPS, Vol. 3, p. 89. He was at that time associated with the Overseas Corporation as scientific officer to the East African groundnut scheme.

In his paper Dr. Bunting pointed out that land clearing includes the following stages, (a) felling, (b) disposal of felling debris, (c) the extraction of the roots, (d) removal of the root and stump debris and

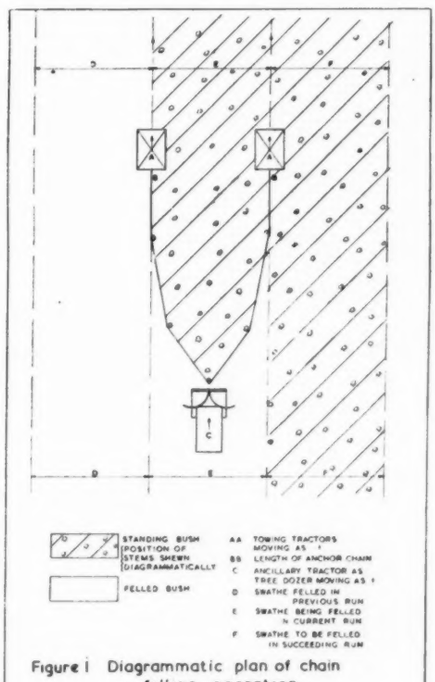

STANDING BUSH
POSITION OF STEMS SHOWN DIAGRAMMATICALLY
FELLED BUSH
AA TOWING TRACTORS MOVING AS 1
BB LENGTH OF ANCHOR CHAIN
C ANCILLARY TRACTOR AS TREE DOZER MOVING AS 1
D SWATHE FELLED IN PREVIOUS RUN
E SWATHE BEING FELLED IN CURRENT RUN
F SWATHE TO BE FELLED IN SUCCEEDING RUN

Figure 1 Diagrammatic plan of chain felling operation

An 8-ft.-diam. steel ' highball ' drawn on a cable between two tractors, fells a tree during clearing operations

Bush flattening by the chain system at Urambo in the Western Province of Tanganyika

(e) the preparation of the cleared land for plantings.

Chain felling

Originally in East Africa pushing the vegetation over with bulldozers was practised, but this was replaced later with so-called chain clearing in which the bush is pulled down by a 120 ft. length of anchor chain attached to two heavy tractors moving on two parallel paths 40 ft. apart. A variant on this has been described in the U.S.A. under the name of ' high balling ' in which a steel ball 8 ft. in diameter is interposed between two lengths of anchor chain. This method is stated to be capable of dealing with trees up to 4 ft. in diameter. It has the advantage of preventing the chain riding up the trees.

Climatic conditions

Much depends on the climatic conditions at the time of clearing. This work is best done after moderate rains when the ground is soft, when many of the stumps can easily be uprooted. After clearing in East Africa the usual practice is to burn the debris. As a preliminary to this, mechanical piling can be practised but is expensive, and hand piling was found to be preferable.

Bad felling leaves many stumps and mechanical removal, *e.g.* by winching, is expensive. After good felling it was found most economical to remove the small number of stumps by hand. Root cutting requires a machine which can combine a succession of horizontal and vertical cuts; no rooter which could do this efficiently was ever put into action in Tanganyika.

Costs in East Africa

In Tanganyika chain felling cost from 34s. to 50s. per acre while piling, burning, stumping and root cutting each ranged from 35s. to 120s. per acre. The total cost of mechanised scrub clearing was from 290s. to 350s. per acre. This was judged uneconomic compared with hand clearing.

Chemical arboricides

In regard to the use of chemical arboricides for killing trees and scrub, a paper by Dr. J. D. Fryer pointed out that the most promising techniques comprise (a) the the killing of individual trees by applying arsenic preparations or ammonium sulphamate to frill girdled trees, or to notches or augur holes; (b) the use of 2-4D or 245T esters in oil sprays applied to the basal 1 ft. to 3 ft. of the stems of trees without any additional mechanical treatment; (c) destruction of bush and trees by either overhead aerial applications of 2-4D or 245T esters in oil, or by drift spraying or hand spraying from the ground. Another alternative is cutting the bush by hand or mechanically following this up with spray treatment. An account was given of the application of these methods to an area of bush scrub in Sierra Leone with encouraging results.

A demonstration in the U.K.

Recently a demonstration of mechanical methods of clearing land was organised by the English National Agricultural Advisory Service on an area of derelict scrub land at Royston in Hertfordshire. There is a considerable acreage of felled woodland in this part of the country which is making no contribution towards timber or food production and which frequently harbours pests. Until recently it was hardly worth while attempting to reclaim this type of land, but the U.K. Government have now made available grants in aid of this kind of

Tractors fitted with bulldozer blades ' pile ' flattened rows of trees and branches which are then burnt

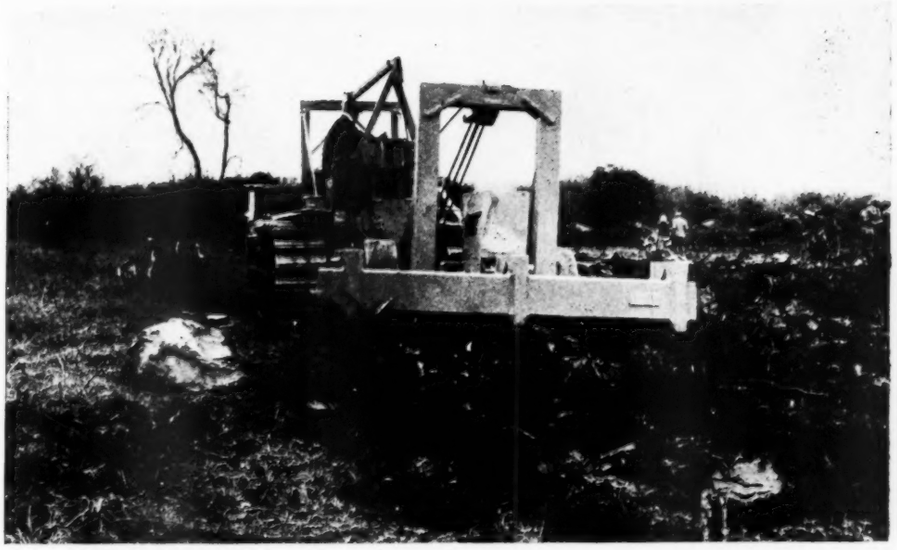
The Foster sabre-slashing machine operated by a Fordson Major tractor

A Ferguson tractor with Stevens grab and buck rake piling debris

reclamation which make it an economic proposition.

Description of the operations

The land in question had an original stand of hardwoods; it was felled early in the last war and since then had grown up in a strong growth of coppice and scrub and contained many old stumps. The soil is derived from boulder clay overlying chalk. With adequate applications of lime and fertiliser this land when reclaimed should be reasonably productive. The demonstration aimed at showing how the land could be mechanically cleared, uprooted, destumped and prepared for the first stages of cultivation. It was organised with the collaboration of a number of contracting firms and comprised four stages. In the first the clearance of scrub and stumps was undertaken by various methods, including the use of rotating saw scrub clearers and the use of muledozers with stinger blade attachments for cutting light scrub and coppice, while the removal of stumps by high explosive charge, by winching and by bulldozer was also shown. In the second stage, following the initial clearing, the collection and disposal of rubbish was dealt with by buckrakes and by Horndraulic loaders. In the third stage the removal of scrub roots was effected by using the Le Tourneau rooter and a Condor ripper. In the fourth stage, after having cleared the scrub and stumps, the initial stages of cultivation were shown, using heavy duty ploughing discs and a single-furrow prairie buster plough towed by crawler tractors. We reproduce on this page photographs illustrating some of these operations.



A Caterpillar D.7 tractor operating the Le Tourneau rooter and (*below*) an International BTD6 crawler tractor towing a disc cultivator

(*Above and below*) **Land clearing in progress at Crux Easton in Hampshire**

Estimated cost of the operation

It is estimated that the cost of mechanically clearing and cultivating an acre of land by similar methods amounts to approximately £75 per acre or, for an area of 10 acres, £750. This is considerably higher than the estimated cost in Tanganyika, which was considered to be doubtfully economic; the same would apply under English conditions were it not for the Government grant in aid of opening up new land. Under this it is stated that an owner would receive a marginal production grant of £25 per acre and a ploughing grant of £10 per acre or, for a 10-acre area, a total of £350. In addition he would be eligible for further allowances against taxable income by reason of initial investment allowance and capital expenditure claim making for an area of 10 acres a further £198 and thereby reducing the net cost to the owner to £202 after 10 years or £20 per acre.

Some comments

Even at existing high labour rates it appears doubtful whether clearing by mechanical means can as yet compete with hand clearing were it not for the existence in the United Kingdom, for example, of the Government grant for breaking new land. On the other hand it must be remembered that it is not fair to compare clearing under European conditions with work in remote tropical areas. A good deal will depend also on whether clearing yields supplies of merchantable timber, and this will depend on the conditions. It may be that in certain conditions the cost of extracting timber will outweigh the value to be derived from it.

It must also be remembered that climatic conditions will have great influence, especially when it comes to dealing with debris and waste materials left after felling. In dry tropical areas and in temperate regions the only possible course is to burn this, whereas in the wet tropics with their high humidity, high temperatures and great microbiological activity, such waste material usually disappears rapidly after it has been piled in windrows; indeed in Malaya the Rubber Research Institute has advocated the abandonment of the practice of burning cleared areas in favour of leaving the work to nature.

In regard to the English demonstrations described above it seems somewhat curious that the chain and ball clearing methods referred to above have apparently not as yet been tried under English conditions to which they might well be applicable.

An additional point

One of the main difficulties encountered both in the United Kingdom and in Africa is the elimination of the mass of roots which accumulate in scrubland and woodland. None of the machines tried in Africa were completely successful, while at the trials at Royston not one of the machines appeared to be performing this part of the operations with complete success. In this connection we reproduce two photos taken on the farm of Mr. Leonard Hill, chairman of Leonard Hill Ltd., at Crux Easton in Hampshire, where he has been carrying out extensive clearing operations. They illustrate the work of a machine owned and operated by Mr. H. R. Nuding which apparently accomplishes these operations successfully with comparative ease.

H.T.

English Ministry of Agriculture Appointments

The Minister of Agriculture and Fisheries, with the approval of the Prime Minister, has made the following appointments: Mr. A. R. Manktelow, C.B., to be a Deputy Secretary of the Ministry in succession to Sir Reginald Franklin, who has retired; and Mr. C. H. M. Wilcox, Under Secretary, to be Principal Finance Officer in succession to Mr. Manktelow.

Sudanese Agriculturalist Studies Farming

Mr. Tewfik Khalifa, who is principal of the Farm Training Centre, Borgeig, Argo, Sudan, is in the United Kingdom until early August on a three months' British Council bursary to study agriculture and farm mechanisation. Until May 30 he was taking a course of training with Harry Ferguson Ltd. at Kenilworth and spent June with the National Agricultural Advisory Service at Wolverhampton. During July he will see something of farming in Cambridgeshire and from July 22 to August 1 experimental farms in the Winchester area.

Mr. Khalifa was formerly technical assistant in the Agricultural Research Division and worked on locust control in British Somaliland. The cost of the bursary is shared between the Sudan Government and the British Council.

Mechanisation in Cotton Growing

W. T. WINTERBOTTOM, C.B.E. and DR. C. B. SAYRE

This paper, which we reproduce in shortened form below, reviews the progress made in recent years in the mechanisation of cotton cultivation in the U.S.A. and elsewhere. In particular, interest attaches to the development of the mechanical cotton pickers which are discussed therein. The paper is by Mr. W. T. Winterbottom, C.B.E., chairman of the Fine Spinners' Association, Ltd., and Dr. C. B. Sayre, who is in charge of investigations on that company's property in Louisiana. It was presented to the International Cotton Conference held at Buxton in May last.

COTTON is among the last of the world's great crops for which efficient field machines have been developed. So far the wholesale substitution of machine operations for hand methods have been confined to Upland types of cotton in the United States. There, replacement of animal by tractor power progressed rapidly in several cotton-growing areas as soon as suitable tractors of light weight and high clearance had been developed. This began in 1924 and by 1940 the draw-bar horsepower on the American cotton fields was estimated at 14 million, of which about 29% was provided by animals. By 1950 the total had risen to 39 million, of which only 5% came from workstock.

More than 10,000 spindle-type cotton pickers and 15,000 strippers were used in picking the 1952 crop, and last year there was a further increase. Their use is so new that many of the first commercial models are still in use.

Requirements for mechanisation

Mechanisation of cotton growing covers a great deal more than the purchase of tractors and mechanical pickers. If mechanical harvesting is to be done efficiently then the whole production system must be co-ordinated to that end. Observation has established that mechanisation is easier in areas which have a sustained pattern of rainfall, *i.e.* a pattern which can be anticipated from season to season. For the same reason artificial irrigation in the low rainfall areas of the South West and the Far West has encouraged mechanisation.

The cotton grower encounters much greater difficulties with the initial preparation of the land in areas which have been pre-empted by such vigorous perennials as nut grass and Johnson grass. In view of the large capital outlay required it is readily apparent that profitable companion crops providing use for much of the same equipment is an important economic factor. An uneconomic situation arises from the prevalence of certain cotton insects. Mechanisation is easier in areas not infested with pink bollworm, for which there are as yet no adequate control measures.

As the new types of cotton-picking machines have been developed, several complementary steps have been taken in research. The most important of these has been the development by geneticists and agronomists of new and improved types of cotton plant. One line of approach has been to modify the cotton plant itself by selection and hybridisation to give plants which mature early, grow to medium height, have wide angle branches and a tendency for the lint to fluff as the cotton boll opens and ripens. The second line of approach by plant breeders which shows great promise, is the development of smooth leaf strains which give better grade of lint when picked mechanically. The reduction of the number of hairs on the under side of the leaf allows the leaf trash to be taken out of the machine-picked cotton more easily during the ginning process and also simplifies cleaning at the mill during the opening process.

The resources available to cotton plant breeders for hybridisation have been considerably expanded during the last decade. Geneticists now find that it is possible to make inter-species crosses in cotton, which opens up a much wider range for improvement than existed when breeding techniques had to be limited to selection and hybridisation between varieties within the American Upland or Hirsutum species. It is impossible to predict how far the new set of fibre properties made available by the new techniques can be fitted together to give improved yarn and improved spinning, but one must recognise that a higher level of general cotton qualities can be obtained in the foreseeable future.

Development of harvesting machines

Mechanical improvements in the harvesting machines themselves since they were introduced have been important, although the basic principles remain the same. There are two distinct kinds of mechanical harvester. The stripper is the less complex, and its use is almost entirely confined to the Texas and Oklahoma areas. The cotton plant in those districts grows differently from those found under irrigation or in the alluvial areas of the Mississippi Delta. It is low growing and has few bolls on each plant, which enables a simpler harvester to be used. The stripper harvester is based on the principle of passing a set of revolving rollers down the cotton row and taking up all the bolls as well as the lint, and a high proportion of the branches as well. About 1,850 lb. of cotton seed and trash are required to make a 500 lb. bale with a stripper, compared with 1,300 lb. with the spindle type of harvester.

The spindle type has two revolving drums with 600 rotating spindles, which are moved by tractor power through the open cotton. The rotating spindles have up-raised barbs which pull out the lint but leave the bolls and the branches on the plant as they sweep past the open bolls. The spindles are tapered so that the lint can be easily doffed and cleaned. The cotton is then taken by suction into a wire basket and subsequently dumped into trailers. Chemical wetting agents are now being added to the water in the spindle-cleaning process. Some of the latest machines weigh much less than the earlier models, which makes them adaptable for use when field conditions are not ideal.

There are now four major farm implement manufacturers making spindle-type pickers. So far they are relatively high priced and low-capacity machines.

Weed control

The one remaining major obstacle to complete mechanisation of cotton growing is the lack of mechanical or chemical methods of weed control. Some progress has been made in the development of chemicals to be applied before the cotton germinates. These partially selective killers have given encouraging results in the control of annual weeds and grasses on a limited scale. There has been some pro-

gress also in the use of petroleum derivatives which can be applied after the cotton plant has emerged to reduce the grass in the cotton rows. Another line of attack has been the use of flame cultivators for mid and late season control. About 50 man-hours per acre are needed for weed control in areas such as the alluvial sections of the Mississippi Delta, using hand hoes in combination with mechanical cultivators. With complete mechanisation this could be reduced to about ten.

Methods in the major cotton areas of U.S.A.

Mechanisation in cotton growing has proceeded farthest in the irrigated areas of the Far-Western States—California, Arizonia, New Mexico and the western part of Texas. The general picture has been ably described by Mr. Cecil Colvette, a farmer near the Casa Grande, Arizona:

> 'Every acre of cotton in Arizona is irrigated. From the time the huge crawler type tractor comes in with gang-ploughs through harvesting, tractors and tractor equipment figure in every operation. About 45%, or 425,000 bales, of our 1953 crop will be machine harvested.'

Much of the hand labour for weed control and for hand picking migrates seasonally from Mexico. Wages are $1.50 to $2.50 a day for hand chopping in Arizona. These rates are much lower than those on California farms, where mechanisation has consequently been further stimulated. About 70% or 80% of last year's crop in California was machine harvested. Mechanisation is much more efficient when the land is level, as it necessarily is in the irrigated fields of California. A high yield (805 lb. of lint per acre in 1950) helps to provide the capital required for irrigation and mechanisation, and with the relatively high level of wages in California has given a further stimulus to the use of machines.

In the cotton-growing sections of Texas and Oklahoma conditions vary widely. Tractor power is used for practically all field operations in the early-harvest area, the Rio Grande Valley, but the availability of Mexican labour at low rates has kept back the use of mechanical harvesters. Cotton growing on the plains of Texas and Oklahoma offers a sharp contrast. There, the climate and the normal cultural practices combine to produce a small plant of relatively uniform maturity, and the use of the stripper type of harvester has proved to be very satisfactory. Weeds and grasses also have a limited growth in the Plains area, so that cultivation requirements are small. The tractor hours per acre are among the lowest in the country, and costs are sufficiently low to make mechanisation profitable in spite of the fact that cotton yields per acre are below average.

In the Mid-South—the States of Missouri, Arkansas and Mississippi, mechanisation has been concentrated in the alluvial areas of the Mississippi Delta. The old plantation system in these States was based first upon slavery and later upon 'share-cropping,' which still flourishes on a 50-50 basis. Mules provided the power, but they will soon have disappeared entirely; the substitution of tractor-power for workstock is essentially completed. Fluctuations in the rainfall pattern, and widespread annual and perennial grasses and weeds have, however, made the elimination of hand labour difficult, and as a result partial mechanisation prevails in the Mid-South. Shortage of labour has forced wages up to between $3.00 and $4.50 a day. Farmers will be forced to press ahead with mechanisation as their labour moves away. In Mississippi, the farm population declined by 22% between 1940 and 1950.

It is estimated that in the conditions existing in the Delta areas of the Mid-South the use of spindle-type pickers handling 100 bales per season per machine will pay if hand picking wages exceed $2.50 or $3.00 a cwt. of seed cotton.

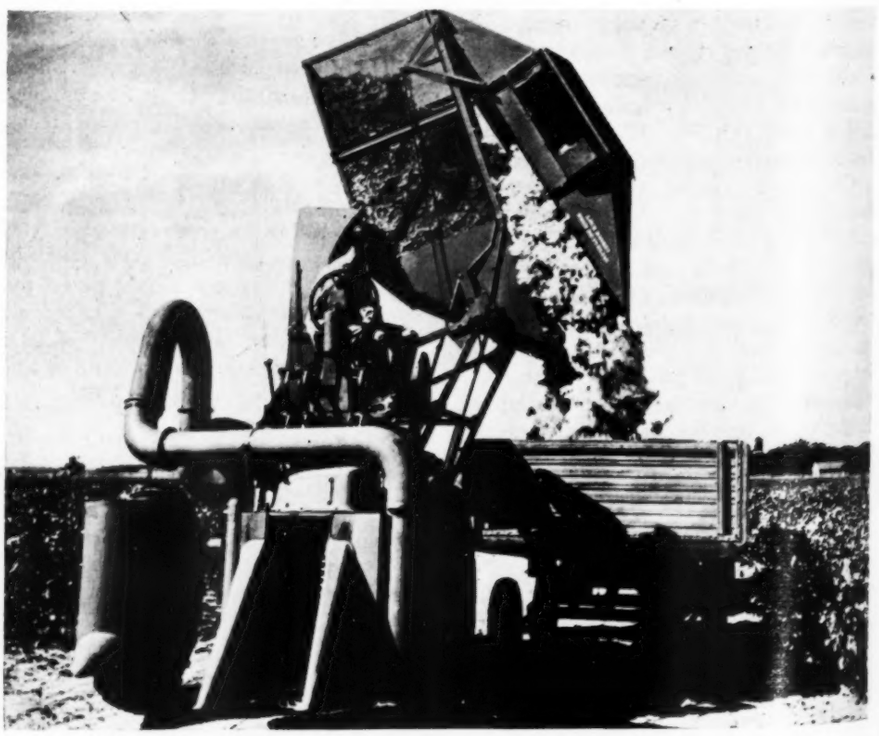
In the South-Eastern States—Alabama, Georgia and the Carolinas—the problem of mechanisation centres around the use of tractor power and equipment on small farms. Alabama can serve as an example. Of the 211,512 farms in the State, 69% produce cotton. The average per farm in 1952 was 10.6 acres producing 6.1 bales each, giving an income of about $1,000. Many of the farms are worked by family labour.

Progress in other producing countries

Mechanisation in the U.S.A. has proceeded in stages. First came the shift from human labour as a source of power to animals—oxen, horses, mules. Then came the changeover to tractor power for pre-harvest operations, and finally the development of mechanical harvesters. So far complete mechanisation has been achieved in only a few small areas of irrigated cotton production and in fringe areas of rain-grown production.

There is a similarity in the extent of mechanisation in countries where the ratio of population to available land is high, and where there are few opportunities for employment off the farm, for example, Egypt, Pakistan, India and parts of Brazil. The main variations are due to the types of cotton produced and the use of irrigation.

In Egypt the number of tractors in use in 1948 was about the same as before the war, with new machines just about replac-



An automatic cotton picker dumps a load into the wagon at the end of a row

ing those worn out. The triple use of cattle for milk, work and meat, and the large numbers of workers available are likely to stand in the way of mechanisation. Emphasis upon quality has been Egypt's logical approach to keeping production competitive when the gross value of the product is considered. Tractor machinery has been introduced experimentally into several other countries in Africa—French Equatorial Africa, French West Africa, Nigeria, British East Africa, Belgian Congo,

Cotton picking by machine, rear view

Angola and Mozambique, but there is apparently little incentive to the widespread introduction of machinery for cotton growing.

Turkey offers a sharp contrast. At the end of the war there were fewer than 1,000 tractors, but recent estimates suggest that in another two or three years 65,000 may be in use. This is perhaps the most rapid move towards mechanisation on the farm in any country in the world. It is reported that about half of the tractors have gone into cotton-producing provinces, and in these provinces mechanisation has advanced most. Generally the use of tractor power is concentrated on land breaking, seed-bed preparation, seeding, cultivation and transportation. The labour supply is considered to be adequate for the level of production immediately after the war, and wage scales were fairly conservative. The widespread introduction of tractor power and associated equipment has apparently been prompted by the desire to increase the acreage and output of cotton. So far there is little mechanical harvesting of cotton in Turkey.

EFFECTS OF TWO METHODS OF HARVEST AND TWO TYPES OF GIN CLEANING IN LINT QUALITY OF COTTON
DELTA AND PINE LAND COMPANY, SCOTT, MISSISSIPPI

	Hand harvested				*Machine harvested*				*Average of all elements*	
	Early and mid-season		*Late and very late season*		*Early and mid-season*		*Late and very late season*			
	•W/O LC	*†W/ LC*	*•W/O LC*	*†W/ LC*	*•W/O LC*	*†W/ LC*	*•W/O LC*	*†W/ LC*	*Hand picked*	*Machine picked*
Grade index	98.9	101.6	86.8	90.0	91.9	95.6	85.1	88.9	94.3	90.4
Grade designation	M–	M–	LM–	SLM–	SLM–	SLM–	LM	LM–	SLM	SLM–
Staple length—$\frac{1}{32}$ in.	33.9	33.9	33.0	33.1	34.3	34.4	33.0	33.0	33.5	33.7
Fibre length (fibrograph)—in.	1.04	1.04	1.02	1.02	1.07	1.06	1.01	1.00	1.03	1.03
Fibre strength—1,000 lb./sq. in.	82	81	79	79	80	80	77	77	80	79
Fineness—micrograms/in.	4.3	4.2	4.0	4.0	4.4	4.4	3.9	4.0	4.1	4.2
Lint (foreign matter)—%	4.2	3.0	6.2	4.9	6.3	5.1	8.3	6.4	4.6	6.5
Picker and cord waste—%	8.8	8.0	11.0	9.7	10.3	8.9	13.6	12.2	9.4	11.2
Neps/100 sq. in. card—web	20	22	30	32	24	24	35	36	26	30
Yarn skein strength lb.—22s.	116	116	109	109	112	112	103	104	112	108
Yarn skein strength lb.—36s.	64	64	59	59	61	61	56	57	61	59
Yarn skein strength lb.—60s.	32	33	30	30	31	31	29	30	31	30
Yarn appearance index	103	99	92	91	96	94	92	92	96	93

•W/O = LC Ginned without lint-cleaning machine
†W/ = LC Ginned with lint-cleaning machine

The rapid move towards mechanisation has created many problems in the training of operators and servicing of the machines. These problems seem to have been fully taken into account in the planning and carrying out of the mechanisation programme. The need for labour for other purposes and the fact that cotton has been a good source of foreign exchange have been key factors. Cotton exports from Turkey as early as 1951 represented 25% of her total exports, passing tobacco for the second consecutive year.

Another type of situation in which mechanisation of cotton growing will require large capital expenditure and much advance preparation to be profitable can be illustrated by Argentina. Many of the soils are clay type and are often referred to as 'heavy.' Power requirements in this type of land are much greater than in areas of sandy and loamy soil. There is also a need for much land reclamation. Extensive experiments with tractor equipment for cotton production have been carried out in Argentina, but the huge capital requirements, limitations imposed by the existing conditions, and the influences of economic policy all seem to combine to hinder progress towards efficiency through mechanisation. This situation appears in many parts of the world; no single condition stands in the way of mechanisation, but the combination of many factors is extremely difficult to overcome.

From personal experience it can be said conclusively that the substitution of machine for animal power, the elimination of hand labour, the associated agronomic improvements which are needed, and the complexities of processing and marketing machine-harvested cotton make the progress towards full mechanisation in cotton growing most difficult and lengthy.

Lint quality considerations

Before the introduction of mechanical harvesting the cotton saw-gin was a relatively simple affair. Moisture is usually added when spindle-type pickers are used, and an excess of moisture makes trash removal difficult. This problem was overcome before the advent of machine harvesters by the application of heat in tower dryer attachments to the gins. These early tower dryers were found in only a few modern ginning plants until mechanisation led to their widespread adoption.

There is danger of damage to the cotton fibres in every additional process if adequate controls are not available and if the operator is not competent and alert. It is generally agreed by ginning technicians that the use of heat above 265°F. on seed cotton will have a significant effect on fibre properties and spinning utility. Often the drying problems are caused by the condition of the seed cotton itself, and some gin operators are attempting to gin cotton which comes in with as much as 20% of moisture.

A number of attachments to condition and clean the cotton between the tower dryer and the gin stand itself have been developed. They all add to the complexity of the plant and of its operation, and the problem of avoiding the additional mishaps which can occur is being tackled by the development of more precise control mechanisms, training schools for operators, and co-operative research by growers, ginners and spinners in the American cotton industry.

A farmer who is considering a change-over to mechanical picking, and equally a farmer who has already made the change, is concerned primarily with relative costs, and one of the foremost influences is the effect of mechanisation on the quality of the lint itself. The attached table gives a comparison of lint quality between machine-harvested and hand-picked cotton based upon experiments conducted by our own research department. Separate comparisons were made during the early part of the season and the late season, because

there is often discoloration caused by adverse weather as the season progresses. Distinction is made also between cotton ginned with and without lint-cleaning attachments.

As a broad generalisation, machine-picked cotton grades consistently lower than hand-picked cotton. Under average farm conditions the difference is commonly estimated at one grade by universal standards. The difference is greater for cotton picked early in the season, partly because the standard of picking by hand tends to deteriorate as the season advances. Much of the machine-picked cotton commonly grades strict low middling under average harvesting conditions, and with a rough estimate of 175 points for the difference in grade between hand-picked and machine-picked cotton the quality differential would amount to $8.75 for a 500-lb. bale.

We consider that our break-even point between machine-picked cotton and hand-picked cotton comes somewhere between $2.25 and $2.50 per cwt. of seed cotton. With 1,300 lb. of seed cotton required to produce 500 lbs. of lint, the additional cost of harvesting a bale of cotton with spindle-type pickers is therefore around $30.00. It is clear that machine harvesting will not necessarily lead to low-cost production of cotton in the future. But it may enable costs to be kept lower than they could be kept without mechanisation since labour, particularly coloured labour, is moving rapidly from the cotton-producing areas to the northern parts of the U.S., particularly the industrial areas.

The future of mechanisation

It is most unlikely that the trend towards mechanisation in cotton growing can be reversed, and it is doubtful also whether anyone with an economic stake in cotton would want it reversed. Mechanisation gives promise, in collaboration with improvements by geneticists and agronomists of the production of better fibres at lower cost.

With such improvements there come changes in the values of cottons, both market value and spinning value. These changes must be appraised by growers, ginners, spinners, weavers and converters, and until the values can be more accurately established through wide experience of machine-harvested cotton, reasonable doubts will exist as to the meaning of mechanisation in each part of the world's cotton industry.

Apart from these considerations, the pressure of economic circumstances, particularly the difficulty of getting adequate supplies of labour for handwork on the farms, is forcing the extension of mechanisation in the United States and elsewhere. Until the remaining obstacles to complete mechanisation in production, harvesting and processing can be removed, however, it cannot be said that mechanisation will lead to cheap cotton or cheap yarn.

Photos: United States Information Service.

Sugar in Mauritius

The picture shows an aerial view of Medine Sugar Estate in the island of Mauritius, located on the dry western side of the island where the rainfall averages only 30 in. per annum, nearly all of which falls in the first four months of the year. In this region cane cultivation is impossible in the absence of irrigation. The photograph illustrates the factory site and the sugar cane fields. In the background in the centre of the picture is seen the La Ferme reservoir constructed by the Mauritius Government 40 years ago, which provides the majority of the irrigation water for this part of Mauritius which makes sugar cane cultivation possible there.

Spraying Prosecution

The first prosecutions in England under the Agriculture (Poisonous Substances) Regulations, 1953, were taken recently against a contractor, who was fined a total of £75, and against his employee, who was fined a total of £20. After hearing the case, and before announcing the fines, the chairman said that as a farmer who makes extensive use of spraying he would not dare to entrust the work to any contractor who did not fully carry out the regulations.

The contractor pleaded not guilty to three charges: (1) Having no register, found guilty, fined £10; (2) for not supplying all the protective clothing required under the Regulations, found guilty, fined £25; and (3) for permitting the worker to carry out spraying when not wearing protective clothing, found guilty, fined £40. On this charge the chairman said it was the employer's duty to see that workers did wear this clothing. The employee was found guilty on two charges: (1) For not wearing protective clothing, pleaded not guilty, fined £10; and (2) for smoking after he had just been spraying and without first washing his hands and face, pleaded guilty, £10.

The regulations, which came into operation on March 31, 1953, prohibit the use in agriculture and horticulture of weed killers and insecticides containing dinitro and organo-phosphorus compounds unless certain precautions are taken.

The Royal Show

THE 114th Royal Agricultural Show was held this year from July 6 to July 9 in Windsor Great Park, this being the fourth occasion on which the ' Royal ' has visited the Royal borough, previous shows having been held there in 1851, 1889 and 1939. It is customary whenever the show is held in Windsor for the president to be the reigning monarch and on the present occasion the patron and president of the show was H.M. Queen Elizabeth II. Her Majesty visited the show on July 7 and 8. The total number of visitors paying for admission during the four days of the show amounted to 143,000 which eclipsed previous records.

As a result of the excessively heavy entries reductions had to be made in the number of pigs and cattle accepted. Among the cattle classes interest centred in the impressive exhibit of Ayrshires, which showed a remarkable uniformity in type. British Friesians also made a very impressive series of exhibits, while there were large classes of dairy Shorthorns, Guernseys and Jerseys. Among the beef cattle attention centred on the Herefords, but the Aberdeen-Angus exhibits were also notable. Exhibits of sheep and pigs well maintained standard shown in previous years.

The principal theme of the exhibit of the Ministry of Agriculture this year was better quality and lower cost. The outdoor exhibits included plots demonstrating factors affecting cereal yields, *e.g.* top-dressing wheat with nitrogen and spring grazing of winter wheat, also effective use of soil water and the combined mole-tile system of drainage. The indoor exhibits included matters in relation to the feeding and management of dairy cattle and poultry, the control of various pests and of various diseases of livestock.

The parade of tractors was omitted from this year's programme. Its place was taken by a special parade of carriages and historic vehicles which had obtained prominence during the last 170 years and also a display showing a meet of hounds in the costume of a century ago.

Silver medals

This year the stands numbered 685 and, as usual, included exhibits of all articles required for farmers. The Burke challenge trophy for a new implement of outstanding merit and the silver medal of the R.A.S.E. were awarded to Wright Rain Ltd., of Ringwood, for a sprinkler irrigation system. Other silver medals were gained by Cooch and Sons Ltd. for a vegetable-washing machine; Dorman Sprayer Co. Ltd. for a knapsack sprayer; Ransomes, Sims and Jefferies Ltd. for a vibro-hoe; Silorators Ltd. for a tractor-drawn forage harvester; Stanhay (Ashford) Ltd. for a seed-spacing drill; Edward Thomas and Co. Ltd. for a rotogate; Vaccar Ltd. for a milk flow indicator, and Transplanters (Robot) Ltd. for a fertiliser distributor.

Machinery at the Show

A portable fire-fighting unit, a special seedbed sprayer and a bale cutter were among the new machines exhibited by **E. Allman and Co. Ltd.** The seedbed sprayer has been designed for spraying forestry seedbeds, but it can, of course, be used for many other purposes. The machine comprises a Villiers Mark 12 engine to which is coupled one of Allmans' new Rollervane pumps which has an operating pressure up to 100 p.s.i. The wheel track is adjustable so as to span seedbeds of various widths, and the tank, which is of 6-gal. capacity, is adjustable on a slotted sub-frame so as to provide for perfect balancing of the machine. The boom is adjustable for height and the offset boom can be used for either side. The drift sheet is made adjustable for height. A special speedometer is fitted, this instrument recording the speed up to 4 m.p.h. and recording the distance in chains and furlongs. Speedometers suitable for the metric system can be supplied.

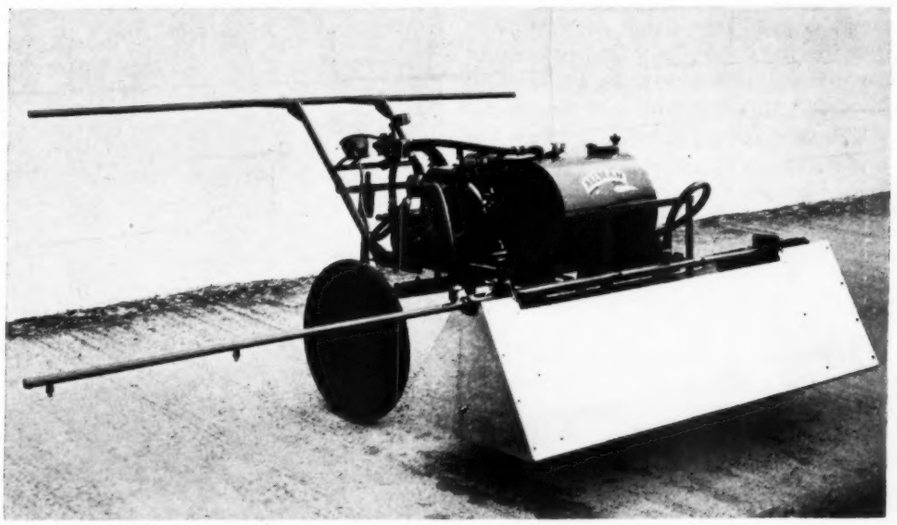
A wide range of machines was shown by **Harrison, McGregor and Guest Ltd.,** among them the Albion No. 20 which is a 5-ft. cut tractor trailer mower and has the following special features: a screw jack for easy hitching, a forward lift lever, self lift, and a new improved cutter bar. The No. 4 swath turner, which was also shown, is similar to the No. 2 swath turner, but includes a new feature. The machine is fitted with a sliding drawbar so that it can be moved directly behind the tractor for towing in narrow lanes. A jack is built into the frame so that sliding the drawbar from one position to another is a one-man job. Several improvements have been made to the company's combine harvester which was shown last year. Also on show was a manure spreader which the company recently introduced.

Roadless Traction Ltd. showed its new rubber-jointed full track machine incorporating the Fordson Major diesel power and transmission unit. It is stated that recent trials have proved the track joints satisfactory.

Geo. W. King Ltd. showed a full size composite working unit of its grain conveying and storage equipment, including the diesel thermatic conveyor and drier, electric suction grain conveyor and electric shaker or vibrator grain conveyor. In addition, the company showed the Rasspe mid-mounted mower fitted to a Ferguson tractor, and a comprehensive range of steel equipment for cattle. There was also shown a range of sliding door gear, precast concrete products, electric pulley blocks and various hoists.

A circular steel storage bin, a worm conveyor, a chain conveyor, a bucket elevator, a portable pneumatic unit and the Aldersley Universal weeder were exhibited by **Aldersley Engineers Ltd.**

A range of K.F.D. conversion tractor models was shown by **Stormont En-**



This seedbed sprayer was shown by E. Allman and Co. Ltd.

gineering Co. Ltd. The K.F.D. 68 conversion, for example, has been designed to meet the needs of users demanding a machine for operating under conditions where minimum height is essential. Compact in design, it retains many features incorporated in the normal Fordson Major. The specially designed front axle allows for greater manoeuvrability when operating in orchards, etc., and the low seating position permits the operator to evade low branches. Ample power at the drawbar allows all types of fruit sprayers to be operated under the most adverse conditions as on hillsides where orchards are so often situated. The Model 68 is said to be ideal for use on such operations as marginal land reclamation and also to be suited for commercial and industrial applications.

Featured by **Weathershields Ltd.** were a canopy cabin on a Ferguson tractor already carrying a Highlift loader, and a similar canopy cabin on the same model tractor carrying a Horndraulic loader. A novel feature of these canopy cabins is that they pivot to permit the elevation of the foreloader to its maximum height.

Whitlock Bros. Ltd. showed an extensive range of equipment, including Fordson and Ferguson models of their Dinkum Digger trench excavators. As a complete working unit there was a pneumatic grain conveying, dressing and storage plant with square silos.

The familiar orange colour of the **Nuffield** ' Universal ' tractor was prominent at the show. No less than ten tractors were exhibited and diesel, V.O. and petrol-engined models were all represented. Fitted to the tractors was a fully comprehensive range of the equipment offered as optional equipment, including hydraulic lift and p.t.o., belt pulley, electric lighting, hand clutch and overload release, etc. Some of the implements most recently approved by the Nuffield Organisation for use with the tractor were also available for inspection on the stand.

The stand of the **Villiers Engineering Co. Ltd.** was a double bay where an attractive and comprehensive display of the company's range of both two-stroke and four-stroke air-cooled engines was exhibited. These power units range from ½ to 5 h.p., and many uses have been found for them.

Among the machines shown by **Drake and Fletcher Ltd.** was the ' Penetrator (Mk. 3) Mistsprayer.' This new machine of the air-assisted type has been specifically designed for low and medium volume application at high pressure on bush and standard trees and hops. The sprayer comprises briefly, a high-pressure

The ' Mistifier ' knapsack sprayer, fitted with trolley, boom and control, shown by Drake and Fletcher Ltd.

double-acting ram pump having an output of 10 gal. a minute at 300 p.s.i., drawing liquid from a 150-gal. tank, and at the rear twin fans. Each outlet can be swung to either side independent of the other and fixed in the desired position. Thus the machine can be used to spray both sides simultaneously in bush fruit or hops, where maximum air blast is not required, whereas when this condition arises in standard trees both units can be directed towards the ' target ' giving a concentrated blast to obtain maximum penetration and coverage.

Exhibits of **Rotary Hoes Ltd.** included the Platypus 30 ' Bogmaster,' a special version of the Platypus crawler tractor which was introduced this year for work on bogs and in swamps; and the Platypus 30 wide-gauge crawler with 46 in. track centres and 12 in. track plates, powered by a Perkins diesel P.4 engine, suitable for agricultural and industrial work. This machine was shown with its new ' Angledozer.' Another exhibit was the Howard trench-digger and pipe-layer which digs the trench and lays drainage tiles in one operation. The trench-digger is mounted on and built into the Fordson Major diesel tractor with which it is sold as one complete unit. The pipe-layer attachment is fitted on the rear of the trench-digger. The Howard Rotavators, ' Yeoman ' and ' Bulldog,' which were described in last month's WORLD CROPS, were also shown as were the ' Bantam ' and ' Gem ' Rotavators.

Visitors to the **Pest Control** stand were able to inspect the trailer and tractor-mounted types of Fieldmaster, an all-purpose machine for spraying at high or low volume, and two types of the low-volume Weedmaster—the bracket model which is bolted rigidly to the tractor and the linkage model which fits into a three-point linkage and can be raised and lowered on it. These were accompanied by the Universal Major (Model U.M.P.P.) which has a very large pump and is designed for high pressure work. Also shown were two hand sprayers, the ' Pesco ' and ' Bambi,' for use in the garden and home or on the farm and smallholding. In

The newest Horndraulic loader, designed for the Massey-Harris 745 tractor, was shown by Steel Fabricators (Cardiff) Ltd.

Bristol Tractors' D.44 operating a three-furrow Ransome plough in stiff soil. Bristol Tractors Ltd. exhibited two other models besides the D.44

addition to the range of sprayers, the company featured the new pneumatic Nodrif Boom, a device for minimising spray drift.

Among the range of equipment shown by **Jack Olding and Co. Ltd.** was the new Boby 'Unidresser' grain and seed cleaner. This has been specially produced for the farmer who requires a relatively small grain or seed-cleaning installation with a moderate outlay, capable of producing a good commercial standard. It has been specially designed for use with a new type 'triple elevator.' The elevator is provided with a small feed hopper into which the grain or seed can be tipped. The stock is fed into the machine and cleaned, the elevator then raises the clean grain and tail corn to two separate sacking-up points. The cleaner and elevator provide a small compact unit which can be easily installed in an existing building. The capacity of the machine is up to 4 tons per hour for roughing out. When cleaning, the approximate capacity is up to 1½ to 2 tons an hour, depending upon condition of stock and amount of tail to be removed.

A new sprayer was shown by the **Dorman Sprayer Co. Ltd.**—the Dorman 'Osprey' pneumatic sprayer which is designed to give constant nozzle pressure. The tank is capable of accepting 90 lb. air pressure and when the on-off control trigger of the hand lance is depressed a pre-determined nozzle pressure can be obtained from 90 lb. downward. Therefore, the controlled application is obtainable for the full contents of the tank. Various lances, nozzles and charging arrangements were shown with this machine. The Dorman 150-gal. saddle tank low-medium volume mounted sprayer was shown on the new Massey-Harris 745D tractor and is supplied complete with a 30-ft. spray boom, rear mounted; boom sections are spring mounted for shock absorption. Other models of the Dorman range were also shown.

Taskers of Andover Ltd. exhibited a new 3-ton, two-wheel hydraulic tipping trailer for Fordson Major, fitted with a new mechanical hitch. This is said to enable a trailer to be easily picked up or detached by the tractor driver without the need for dismounting, the towing eye being incorporated with a sliding mechanism working along an inclined slotted ramp.

The new F.R. four-furrow plough at work. This implement is not fitted with a land wheel as depth of work is adjusted by means of the pre-set linkage mechanism on the tractor

The pre-set linkage control and new F.R. four-furrow mounted plough for the Fordson Major were both shown for the first time. This new equipment is the result of the combined efforts of the **Ford** and **Ransomes** design teams. The pre-set linkage control can be fitted at the time of manufacture or to current Fordson Majors in service. It dispenses with the need for the plough land wheel and all other control with the exception of the one for front furrow width. The mechanism of the pre-set linkage, used in conjunction with the standard hydraulic lift equipment, controls the position of the implement in work by merely pre-determining the amount the lift arms fall as the plough is lowered.

The Four Oaks Spraying Machine Co. Ltd. showed its range which included the 200-gal. trailer unit. The spray boom is designed to give good coverage up to approximately 40 ft. width. The two end portions of the boom can be removed, giving a spray width of approximately 30 ft. The boom can be folded to overall width of 6 ft. 6 in. It is fitted with 24 nozzles. Nozzles are available to give from 5 to 40 gal. per acre at 4 m.p.h. The wheels are adjustable on the axles to give maximum centres of 4 ft. 7 in. and minimum of 3 ft. 4 in.

Two ploughs were included in the machinery exhibited by **Ransomes Sims and Jefferies Ltd.** The Hawk TD.18 four-furrow mounted disc plough, which can be fitted to medium powered tractors equipped with hydraulic lift, will plough 10 in. deep in medium land and can be set for furrows 8 in., 9 in. or 10 in. wide. The strong angle steel frame incorporates a universal coupling plate to accommodate linkages of different tractors. The other plough, the Condor TD.19, a two-furrow reversible or 'one-way' disc plough, is also directly mounted in the same way. It is designed for work up to 10 in. deep and the furrow width can be adjusted from 10 in. to 12 in. A lever within easy reach of the tractor seat reverses the discs and locks them in position to work in the return direction. The reversing mechanism is carried on a casting bolted to the main frame and is provided with large diam. ball bearings to ensure easy reversing.

Some of the company's wide range of spraying and dusting machines were to be seen on the stand of **Cooper, Pegler and**

Co. Ltd. The new machines were: The ' Super ' knapsack sprayer with lead-coated copper tank; the ' Hypermicrover ' charging group; and the ' Vitiver ' charging group. Other machines shown included the ' Paluver ' pneumatic knapsack sprayer, which conforms to the requirements of the World Health Organisation, and the ' Toxaver' lightweight power dusting outfit.

On the stand of **Johnston Brothers (Contractors) Ltd.** was shown the new Digger Fork attachment for fixing to the ' Roerslev ' single-row topper to enable the small grower to have a complete harvester. The topper can, of course, be used simply as a topping unit as it is now known and afterwards as a lifter unit, prising the beet out of the ground for subsequent hand loading. Topping and lifting may be carried out in one operation.

Four new additions to the Ferguson range—a side delivery rake, a dump skip, a hedgecutter, a two-furrow 10-in. standard plough and the recently introduced Massey-Harris 745 diesel tractor—were among the many exhibits on the **Massey-Harris-Ferguson** stand. The No. 745 diesel tractor replaces the No. 744D. The tractor is fitted with a four-cylinder Perkins engine and develops 45 h.p. at 1,500 r.p.m. The side delivery rake is a development of one originally designed by Ferguson engineers in America and used there and in Australia for some years. Being three-point linkage mounted, rake and tractor work together as a close compact unit giving maximum manoeuvrability and ease of control. The hedgecutter is pneumatically driven by a tractor-mounted air compressor, the ' Hydrovane 25,' which is also newly released as a Ferguson product, and which can be used with many other air tools. It consists of a light-alloy comb, a blade with a short saw section on the back for cutting timber up to 6 in. diam., a motor unit and a handle containing a filter element and hand control valve.

Tractor Shafts Co. Ltd. showed a fertiliser attachment for its ' Smallford ' three-row automatic potato planter. Three hoppers with regulated flow provide fertiliser distribution simultaneous with planting. Each hopper holds ½ cwt. and there are ten different rates of sowing for each seed ' setting.'

For the first time at the Royal Show, the **Wolseley Sheep Shearing Machine Co. Ltd.** exhibited its new range of electric fence equipment specially designed for fencing and folding pigs and sheep. New hairpin posts with spikes angled into the ground form the corner supports, to which are attached the strainer and reel, and new corner insulators. These corner insulators replace the porcelain egg insulator through which it was necessary to thread the wire, while with the latest type the wire can be inserted into the insulator after it has been fixed to the post, not threaded through, and removed from the corner post instantaneously.

Servais Silencers Ltd. showed its range of ' Servais ' straight through silencers, which are suitable for all types of tractors, and for engine-driven lighting plants, milking machines, cultivators, etc., giving quiet operation.

A new addition to the range of **Salopian** pick-up balers was exhibited. This baler is the Model 54 and is a medium capacity baler designed for p.t.o. drive. It includes a number of innovations and is said to incorporate many features which ensure high output. It has an overall length of 18 ft., height 5 ft. 4 in., 16 h.p. tractor required, and a capacity of 4 tons/hr.

Chemicals exhibit

An instructional exhibition was staged by **Shell Chemicals Ltd.** Entitled ' Battle for Harvest,' its theme was the unceasing competition for food between man and insect. As an introduction, British crop losses due to insect pests are graphically depicted and then the habits of the common pests are held up to scrutiny by models and by highly magnified photographs. Different forms of insect control are shown and the exhibition then focuses on chemical methods explaining what is required of an efficient insecticide, how it works and where and when it should be applied. The further development of control measures is portrayed by photographic records of field trials and laboratory experiments in Britain and abroad. Some of these show the results of trials with aldrin and dieldrin. An independent section deals with ' War Against Weeds ' and demonstrates the effectiveness of modern selective weed killers.

The **I.C.I. and Plant Protection** stand was designed primarily as an information centre for farmers and growers. The principal themes were food production, plant protection and animal health; pictures and panoramas showed how I.C.I. fertilisers, pharmaceutical products, plastics and metals, and Plant Protection weedkillers, insecticides and fungicides help farmers at home and overseas to feed the world's growing population. Emphasis was laid on I.C.I.'s and Plant Protection's extensive programmes of agricultural research in the laboratory and in the field.

Forestry Tushing Thinnings

In the June issue of WORLD CROPS on page 256 we reproduced a photograph showing moving tushing thinnings from a larch plantation by means of a horse, coupled with a query as to when this would be done mechanically. We have since received a communication from the Massey-Harris-Ferguson organisation in which they point out that in Scandinavia standard tractors are now in use with a Swedish sledge for carrying out tushing operations similar to that illustrated in our picture. In most Scandinavian countries, particularly in Norway, it appears that Massey-Harris-Ferguson tractors have produced a minor revolution and forests which could not be economically exploited ten years ago are now being worked methodically with the use of tractors. We reproduce a photograph of a Ferguson tractor with Swedish sledge operating in denser growth than that in our earlier photograph.

Open Day at the National Institute of Agricultural Engineering

IT is the practice at the National Institute of Agricultural Engineering at Silsoe in Bedfordshire to hold open days once every two years, at which the institute is thrown open for inspection and opportunities given to all interested to see the various lines of work in progress. The last open day was held in July 1952. This year, in order to enable the work of the institute to be seen at another season, the open days were held on May 25 and subsequent days. As on previous occasions, most of the exhibits shown were static and no attempt was made to arrange a demonstration of machinery working under practical conditions.

The programme, as in past years, covered field trials, time and motion studies and research for evolving new techniques and designing new machines. It is a feature of the work of the institute that close touch is maintained with other agricultural research stations, particularly in regard to the building and designing of experimental equipment and the testing of all classes of tractors and agricultural and horticultural machines.

As is well known, it is the policy of the institute to publish information in the form of technical memoranda and reports. These are issued as soon as possible after the work has been carried out and since 1952 many more have appeared. These are necessarily written in scientific or technical terms, and it is important to note that all work is aimed at anticipating the future needs of agricultural mechanisation.

The programme of this year's display was arranged under the same general headings as in 1952, although since then certain lines of work have been completed or discontinued and many more have advanced to a more developed stage. The demonstrations included research on the wheel performance of tractors and developing the results obtained with the single-wheel tractor, which was mentioned in our report of the last demonstration (see WORLD CROPS, Volume 4, page 326).

Laboratory work has included experiments on the further development of the work of Coulomb and Morin on rolling resistance. A feature of this section was the hydraulic tractor mentioned in our previous issue, which was demonstrated and impressed all present by the ease with which its movements could be controlled. Another item which attracted attention was a tractor with over-sized wheels devised for cultivation in rice fields. Other items included a tractor recorder which is designed to register the operations of a tractor on the farm.

The National Institute of Agricultural Engineering

Soil influence

Another line of investigation in progress is one which aims at elucidating the influence of soils at a particular point of the performance of a tractor. In relation to the latter point, various lines of work were demonstrated, aiming at such things as determining the strength of soil clods, the adhesion of particular soils in relation to controlled moisture contents and the measurement of the loads of plough bodies on a variety of soils at different speeds.

Mechanisation of sugar beet

An elaborate demonstration was given of the mechanisation of sugar beet and other row crops. The technique of down-the-row thinning is being investigated and was demonstrated by a thinner in operation. Another demonstration which attracted much attention was that of a machine for mechanically digging trenches in the field and which appeared to offer considerable possibilities in the making of water furrows for irrigating crops.

Other demonstrations

Other matters demonstrated included pest disease and weed control, the drying, handling and storage of grain crops, green crop conservation, irrigation, the heating and ventilating of glasshouses; of special interest was the increasing amount of work which is being undertaken in relation to overseas crops, mainly at the request of the Colonial Office. These include a tractor-mounted machine for stripping the fibrous bark from stems of jute and jute substitute crops and a harvester developed at the request of the Overseas Food Corporation for the digging of groundnuts and stripping the nuts off the plant in one operation.

The demonstration was well attended and great interest was evoked in the numerous items exhibited. There is no question that the value and utility of the institute are becoming increasingly widely appreciated both in England and overseas, while the nature and extent of the work in progress is an indication that as the years go by the importance and value of the institute will be increasingly appreciated.

Technical News

The following articles appear in the August issue of *Food Manufacture:* ' Kenya Meat Commission Factory at Athi River, Nairobi ' ; and ' Standards for Quick Frozen Foods.'

In the August issue of *Paint Manufacture*, Prof. K. Magnusson writes on ' Thermal Radiations and Paint Films,' while F. Armitage continues his ' History of Paints and Varnishes in Great Britain.'

Fibres (*Natural and Synthetic*) for August is a special issue dealing with dyes and dye chemicals. Articles include ' Influence of the Dyeing Method on Wool Wearing Properties,' by Dr. Paul Fink; ' The Dyeing of Dynel,' by J. A. Field; and an account of the annual conference of the Textile Institute held recently on ' Colour and Textiles.'

An article on ' Beet Sugar Refineries ' appears in the August issue of *Chemical and Process Engineering*.

NEW BOOKS

Manures and Fertilisers—Potential Progress in Europe

O.E.E.C. Pp. 117. Paris. 1954. Obtainable in U.K. through H.M.S.O.

This European working party's report makes an outstandingly good contribution to the modern 'soil fertility library.' Indeed, it may be doubted whether the relationship between humus and fertilisers has ever been so clearly and logically discussed, at any rate at relatively short length. What progress has recently been made, or still remains to be made, in Western Europe in minimising the farm losses of animal and liquid manures? What has been the effect upon soils and their productivities of increased fertiliser usage and reduced mixed farming—have soils no longer regularly receiving animal manures yet annually raising fertiliser-fed crops developed serious symptoms of decline? What improvements are being made or can be made in methods of using fertilisers? These are the main questions the working party has studied.

In a sense their report is an interim one. Certainly no final conclusions have been drawn; the *trends* of change have been objectively assessed, however, and in this way the long-term dangers of merits of modern soil practice have been estimated. Over so wide an area, of course, soil type differences and climate differences prevent practical generalisation. The sandy soil will show the ill-effect of humus decline far more swiftly than the heavy, clay-colloid soil; in dry areas the dwindling of moisture-holding colloidal matter in soils will limit output far more than in wettish areas. The working party has skilfully prevented the wood of principles from being obscured by the trees of local detail.

The main value of the book is to be found in its several appendices. These take up a little over half the book's space, and many books of greater size have dealt much less factually with such subjects as the value of organic matter and humus, methods of using NPK fertilisers, secondary and trace nutrients, soil analysis, liming, and grassland manuring. Europe's experimental evidence and experience with all its width and depth are drawn upon with excellent selectivity, especially on the first and last of the themes just listed. Few agronomists, however expert, will not be better informed after studying these appendices. Rothamsted's long-term test data are liberally used, but they are significantly accompanied with other long-term data, notably from Germany.

The agricultural literature published by OEEC has already established a high standard. This latest effort, however, will be regarded by most readers as by far the best both in purpose and performance. The working party, in which France, Germany, Norway, Italy, Britain, and Belgium were singly represented, has given us the benefits of composite experience without the customary evils of composite thought and authorship.

D. P. HOPKINS.

Farm Management Crop Manual

By R. L. Adams. Pp. 177, loose leaf. Revised edition. University of California Press. 1953.

This manual consists almost entirely of data, collected over the past 40 years, concerning all aspects of the production of crops in California. Much of this information is not static so that constant revision is necessary. The loose-leaf system in which the book is bound enables the reader to keep the manual up to date by the replacement of pages as revised data is published.

The first part of the book consists of a lengthy table setting forth the average prices paid to producers for California field, fruit and truck crops. Part 2 deals with the method of calculating costs and presents standard costs for the more usual farm operations. Typical costs of producing for sale 48 of the principal crops grown in California is stated in some detail in the third part of this volume. General information relating to each crop is given, such as principal producing areas, soils, climate, and topography, followed by a discussion of the various operations basic to the production of the crop, and supported by a comprehensive estimate of the cost of production.

It is not intended that these statements of production costs be accepted as of universal application. Necessarily, costs vary from farm to farm, being governed by such factors as size of farm, soil, topography and water supply. They do, however, represent average good conditions and serve as a useful guide to farmers who are not fully conversant with comprehensive costing systems.

While the manual relates to crops and conditions in California, it contains a wealth of detailed information of universal application. Costs are stated in U.S.A. currency, but the basis of costs is stated in man-hours, while the operation of implements are given in acres per day and hours per acre.

The author is of opinion that the manual 'should prove useful to farm managers, appraisers evaluating farms for loan or taxation purposes, to investors, and to students studying farm management, provided the data are utilised in a proper and intelligent manner, by making allowances and adjustments to fit specific cases.' A book which has proved useful for nearly half a century is likely to retain its popularity in an age when the value of close costing is more fully appreciated than ever.

D. H. GRIST.

Proceedings of the First British Weed Control Conference 1953

Pp. viii + 484. London. The Association of British Insecticide Manufacturers. 1954. 30s.

The first British Weed Control Conference was held on November 3-5, 1953, at Margate under the auspices of the Ministry of Agriculture, the Agricultural Research Council, the Association of British Insecticide Manufacturers, the British Agricultural Contractors' Association and the National Farmers' Union. It was reported in WORLD CROPS at the time.

The present mimeographed volume contains the record of the proceedings of the conference which constitute a full report of the 12 formal papers and 33 research reports presented there and the discussions thereon. The report of the recommendations sub-committee and a list of members are also included. The formal papers covered the following subjects: The cost of weeds; weed problems in forestry, grassland, fruit and vegetable crops; weed seeds; and spraying problems. The research reports dealt with: The effects of 2,4-D and MCPA on cereals; comparisons of 2,4-D and MCPA; formulations of the esters of growth regulating herbicides; application volume rates; weed control in clovers, lucerne, seedling grasses, sugar beet and sports turf; the ecology of *Senecio jacobaea*; *Juncus* spp.; *Ranunculus* and *Avena* spp.; the control of *Calluna vulgaris*; *Equisetum palustre*, *Pteridium acquilinum*, *Juncus* spp., *Agropyron repens*, *S. jacobaea* and *Avena* spp.; weed control in ditches and on roadsides; and reports on CMU and crop dessicants.

Mauritius-Burma Rice Agreement

Mauritius will buy 40,000 tons of rice in 1954 from Burma and between 35,000 and 50,000 in the years 1955-57 under a four-year rice agreement signed recently between the two countries.

Reports and Publications

Annual Report of the East African Agricultural and Forestry Research Institute for 1953.

It is only eight years ago since the project for the organisation of an East African Agricultural and Forestry Research Institute was first envisaged. Since then it has been inaugurated and, despite difficulties arising from rising costs of labour and materials and above all from the disturbed conditions which have prevailed in the region of Kenya chosen as the site for the new institute, it has achieved a standing and scope in accord with the ideas which underlay its foundation. It is, of course, the successor of the former East African Agricultural Research Institute at Amani. Alongside it have also arisen a number of other research organisations, namely, one for veterinary research, one for fresh water fisheries, and one for marine fisheries. A notable advance during the year was the creation of a governing body for the whole of this group of research organisations.

Today E.A.A.F.R.O., as it is commonly referred to, maintains a staff of some 44 scientific officers with ancillary administrative and technical staffs, it is housed in a block of modern buildings specially designed for the work they are intended to do, while the work itself falls under 16 different heads of scientific investigation. Such an achievement in a comparatively short space is obviously a matter for congratulation to all concerned.

Turning to the report iself, although the Kenya Mau Mau Emergency extended over the whole of 1953, there were nearly 600 visitors to the station. This was about 50% greater than in 1952. It can be concluded that the activities of E.A.A.F.R.O. are being adequately publicised.

Striking advances have been made in dealing with the grave threat to the East African maize crop by the rust disease which is sweeping over Africa. Swift action in the research laboratories at E.A.A.F.R.O. and full co-operation with the territories has greatly reduced the danger of devastating losses. A number of resistant seedlings have been raised from imported seed; these are being distributed to departments of agriculture.

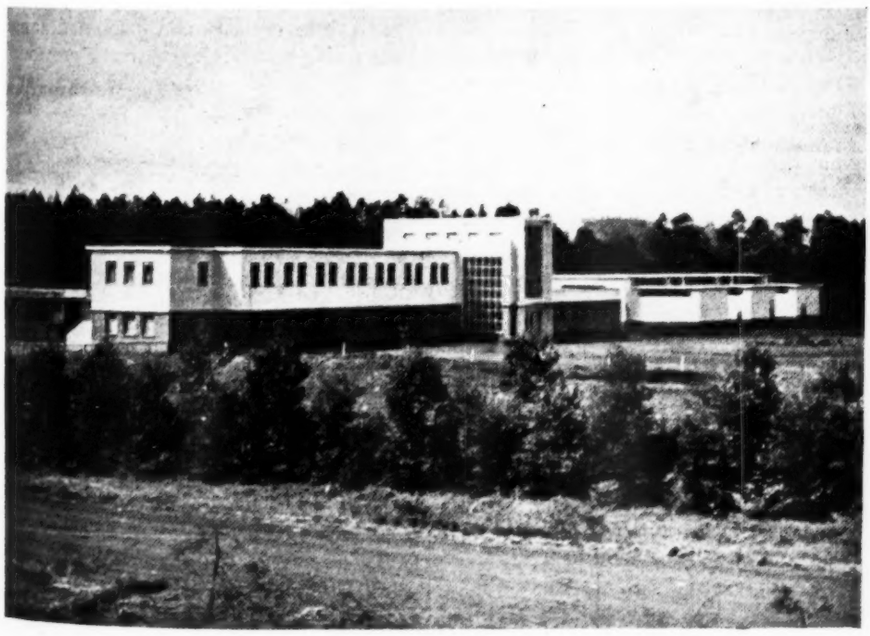
Research on the reliability of rainfall has led to several developments. The fluctuations in the yearly total of rainfall and its distribution are so violent that yearly averages have little meaning. What is badly required is a knowledge of the reliability of the rainfall, or what is the chance of receiving less than a certain amount of rain in the year? Using ordinary rainfall data these chances have been worked out for the whole of East Africa, employing two standard annual averages of 20 in. and 30 in., and maps have been constructed showing by zones the various degrees of probability. They are of use in the selection of areas for settlement and development, in assessing the need to construct dams for holding surface water for stock, and in deciding what particular systems of agriculture can safely be introduced in any specified area.

Of great importance are the physical soil studies at E.A.A.F.R.O. The structure of the soil, the amount of water that passes below the root range of plants, and goes to replenish the underground water supplies, the amount that is evaporated into the atmosphere, and the amount retained in the soil, are all of great significance. The soil physicist has been able to develop methods for studying all these terms, and of providing answers to a considerable number of practical questions. Typical questions are, what is the effect on the water balance of replacing forest by plantation crops? How much water reaches the underground water-table in different systems of agriculture? What are the best methods of protecting the soil surface to ensure the greatest penetration of the rain and the minimum of run-off?

Animal husbandry problems have also been under intensive study during the year, in close co-operation with the territorial departments. Owing to the overwhelming economic importance of cattle in East Africa, smaller livestock have received hitherto much less research attention. It is therefore appropriate that studies on pigs, sheep and poultry should be made. Many unsolved problems of animal husbandry connected with cattle can be given a preliminary study with smaller animals, thus allowing results to be obtained more quickly than with the slowly maturing cattle.

Space does not permit us to touch on the many other lines of activity in progress, but enough has been said to show the wide range of the organisation's work and to indicate the increasingly valuable part which it is playing in the East African agricultural economy.

H.T.



The headquarters of the E.A.A.F.R.O.

Productivity in the Fertiliser Industry

Last year the British fertiliser industry delivered to farmers during 60 critical days of the spring planting season enough fertilisers to make a hill 1,000 feet high and half a mile broad at the base. Smaller but still sizable deliveries continued throughout the year at a total cost to the farmer of £67,250,000. The methods of handling and manufacture of this enormous mass of material with its important influence on the cost and quantity of food production are the subject of the 14th Review published by the British Productivity Council of the industries which sent productivity teams to the United States of America under the auspices of the Anglo-American Council on Productivity. Representatives of the British superphosphate

and compound fertiliser industry visited America in 1949 and the steps taken by firms in the industry to improve their methods have, in the main, followed the lines suggested by the productivity team in its report, published in 1950.

The review is entitled 'Agriculture's Barometer,' as it is felt that there are few more sensitive pointers for recording the fluctuations of Britain's agricultural prosperity than the purchase by the farming community of fertilisers. Since the beginning of the last war there has been a vast increase in the use of fertilisers and in particular of nitrogen, the consumption of which rose from 77,000 tons in 1939 to 230,000 tons last year. Probably the consumption would have been still greater but for a certain wariness on the part of some sections of the farming community over possible variations in guaranteed prices and import tariffs on foodstuffs.

Among the major developments in fertiliser manufacture since the war have been an expansion in the production of granulated fertilisers, the setting up of triple superphosphate plants and the development of ammoniated superphosphate and nitrophosphate. Probably the most significant post-war development, however, has been the introduction of mechanical handling equipment, which has taken the backache out of the job. The review refers to many of the steps which have been taken in this direction by firms of all sizes.

Undoubtedly, the greatest problem with which the industry is faced is that of storage. Last year during the peak season (February-April) the industry moved 3 million tons of fertiliser in the 60 days referred to and, in addition, had to handle over 1 million tons of raw materials. The review suggests that farmers be encouraged to relieve this position (possibly through special bank loans) by constructing additional storage buildings and taking delivery during off-peak seasons.

The Report of the Land Settlement Association Ltd. for 1952-53

Founded during the years before the last war the Land Settlement Association was originally designed as a means of exploring the possibilities of land settlement as a means of solving the problem of unemployment which was so serious and distressing in what had become known at that time as the depressed areas, and which included mining and heavy industry in Northern England and Wales. The idea underlying the scheme was to endeavour to ascertain whether by settling unemployed workers in these industries on properties in the country, providing them with homes and the necessary equipment and facilities, and giving them some training and guidance it might be possible to convert them into prosperous smallholders. With the outbreak of war the continued need for these settlements in their original guise happily disappeared since under the pressure of war-time needs practically all the original settlers became reabsorbed in the industries which they had abandoned and the settlements were continued as an attempt to facilitate the advance of the agricultural wage-earner into the ranks of farmers. The scheme has been in progress under these new aims since the early days of the war. The present report shows the progress made during 1952-53.

The figures of produce marketed indicate justification for the association's claim that the scheme contributes very materially to the production of food in this country. The scheme is implementing the policy of the Minister of Agriculture and Fisheries to facilitate the advance of the agricultural wage-earner into the ranks of farmers by advancing loans up to 75% of the capital required. The tenants are provided with services to enable them not only to get the best results from their holdings but also to purchase their farm requisites, pack and market their produce on a centrally organised basis. One unique feature of this scheme is that matters concerning production policy, or in other ways affecting the interests of the tenants, are determined after consultation with the representatives of the tenants.

The quality and packing of the association's produce has maintained its high standard and new methods of packing, marketing and improving the technique of cropping, are constantly studied so as to attain the greatest efficiency and consequently, the greatest return to the producer. For the agricultural worker with small capital this scheme offers an unparalleled opportunity to farm on his own account. Vacant holdings occur from time to time and are advertised in the Press.

WORLD CROPS

OUR NEXT ISSUE will deal mainly with rice production and prospects throughout the world. **The Possibility of Increasing Rice Production** will be discussed by D. H. Grist, and E. O. Adair will write on **Rice Production in the United States.** There will also appear in this issue Part 3, **The French Cameroons,** of the article on cocoa in West Africa by D. H. Urquhart and G. A. Ross Wood.

The Chelsea Show

The holding of the Royal Horticultural Society's annual show in the grounds of the Royal Hospital, Chelsea, is always an outstanding event of the London season and one which is looked forward to by thousands of horticulturists, professional and amateur, throughout the United Kingdom.

This year's show which took place from May 26 to May 28 was no exception to the general rule and yielded nothing to its predecessors in the magnitude and the magnificence and interest of the exhibits which appeared. The great marquee, believed to be the largest in the world, was packed with marvellous floral groups, *e.g.* roses, delphiniums, and begonias of extraordinary size and beauty, sweet peas, new varieties of hydrangea, and an amazing collection of orchids including some specimens from exhibitors overseas.

During the weeks which preceded the exhibition the cold and inclement weather had proved a source of gloom to the organisers and exhibitors. Fortunately during the show itself the heart of the clerk of the weather relented and throughout the weather was almost all that could be desired, with warm sunny days and an almost complete absence of showers.

As usual a feature of the show was the series of specimen gardens displayed by firms of landscape gardeners. Each year these seem to eclipse the previous season's efforts, and on the present occasion some truly remarkable gardens appeared. Many of them presented an aspect of formal and settled beauty which appeared to betoken years of loving care and it seemed almost incredible that but a few weeks previously the sites of most of them had been simple stretches of turf within the precincts of the hospital grounds.

The trade display included stands by many firms showing as usual a wide range of horticultural and garden implements, manures, fertilisers, pesticides, weedicides, etc. Among firms represented were Ransomes Sims and Jeffries, Rotary Hoes, Plant Protection Ltd., Four Oaks Spraying Machinery, the Murphy Chemical Co., and many others.

Among the research institutes which arranged displays were Long Ashton Research Station, East Malling Research Station, Cheshunt Research Station, the John Innes Institute, all of which demonstrated various branches of their work in relation to horticultural problems, while for the first time the Commonwealth Agricultural Bureaux had a stand on which their publications were displayed.

WORLD CROP REPORTS

WORLD

Sugar production. World production of centrifugal cane and beet sugar for 1953-54 is estimated now at almost 40 million short tons, raw value, which is 1 million tons over the November estimate of 39 million tons. The current figure is 10% higher than the 36.4 million tons (revised) of 1952-53, 4% above the 38.3 million tons of 1951-52, and 40% above the pre-war (1935-39) average of 28.5 million tons.

The production of non-centrifugal sugar is estimated now at 7.1 million short tons, tel quel, in 1953-54, compared with 6.8 million tons (revised) in 1952-53, an average 6 million tons for 1945-49 and an average 5.4 million tons for 1935-39.

World production of centrifugal cane sugar equals the record 24 million short tons, raw value, of 1951-52 and exceeds the 1952-53 crop by more than 3%. Reduced output in the large producing areas of Cuba, India and Puerto Rico during the current and previous seasons have been offset by increased production in almost every other cane area in the world.

Beet sugar production reached 15.9 million short tons, raw value, during 1953-54, 900,000 tons higher than the fall estimate for the season, 20% higher than the 1952-53 estimate of 13.2 million tons (revised) and 8% above the previous record of 14.7 million tons during 1950-51. While increased output is reported from every beet sugar-producing area of the world, the bulk of such increases is centred in Western Europe where excellent weather finally settled on beet acreage expanded during the post-war period.

North and Central America. Production of centrifugal cane and beet sugar in North and Central America is estimated now at 13.3 million short tons, raw value, during 1953-54, about 2% more than the 13 million tons of 1952-53 and 12% less than the 15 million tons of 1951-52.

Cuba has restricted its crop to 5.4 million tons since the fall estimates to conform with the 15% export quota decrease instituted in early 1954 under the new International Sugar Agreement. This further restriction of Cuban output has been offset largely by upward revisions for production in most of the other areas of North and Central America. The most important increases in production from the 1952-53 season are noted for the continental cane and beet areas of the United States, the Dominican Republic, Mexico and the British West Indies.

Western Europe. The centrifugal sugar production of Western Europe is now estimated at 7.8 million tons for 1953-54, about 30% above the 6 million tons of last season and 20% above the 6.5 million tons of 1951-52.

Total beet acreage of Western Europe during the post-war period increased by 50% through 1952-53. Only adverse weather and disease factors during 1951-52 and 1952-53 prevented record crops for those seasons. During the current season, acreage declined in most areas of Western Europe. Yet, such excellent conditions have prevailed this past year that a record crop, more than double that of the early post-war (1945-49) period, was assured. The most striking increases are noted for sugar production in France and West Germany. In the former country, beets, which formerly moved into alcohol plants, are moving now to sugar factories, and a surplus of sugar is expected for the first time. West German sugar production increased this season by 60% with favourable weather conditions on increased acreage. Other important production increases are noted for Belgium, Denmark, Sweden, the United Kingdom and Yugoslavia.

Eastern Europe. Centrifugal sugar production for Eastern Europe during 1953-54 is estimated at about 3 million short tons, raw value, compared with 2.7 million tons (revised) for 1952-53 and 3.1 million tons for 1951-52. Increased production in most areas of Eastern Europe more than offset the continued decreases for Eastern Germany.

The revision of 1953-54 output for the U.S.S.R. to 2.7 million tons is based on reports indicating improved weather conditions during the current season.

Asia. The estimate of 1953-54 centrifugal sugar production for Asia remains at almost 5 million short tons, raw value, compared with 4.9 million tons in 1952-53 and 4.6 million tons in 1951-52. Because of its reduced output of centrifugal sugar, India will need to import sugar again this year to supplement domestic production and to hold down prices in that country. Reduced output in Formosa resulted primarily from a damaging typhoon in November and continued adverse weather during December and January. Every other producing area of Asia maintained or increased production from last season's levels.

South America. Centrifugal sugar production in South America advanced 9% to 4.6 million tons in 1953-54, or more than double pre-war output. Argentina, Brazil, British Guiana, Colombia, Uruguay and Venezuela produced record crops. Peru and Ecuador held production near last season's record levels and only Paraguay reported a serious drop in production during the current season.

Africa. The 1953-54 centrifugal sugar production of Africa is estimated now at almost 2.1 million short tons, raw value, or 8% above last season's output of 1.9 million tons and 21% above the 1.7 million tons of 1951-52. Only British East Africa reported a decline in production this season. The four largest producers, the Union of South Africa, Mauritius, Egypt and Reunion, reported record crops for 1953-54.

Oceania. The 1953-54 record crops of Australia and Fiji totalled almost 1.6 million short tons, raw value, or one-third more than the 1.2 million tons of 1952-53. The 1953 season was an unusually favourable one for Australia. On acreage about 23% larger than in 1952, about one-third more raw sugar was produced. Prospects are also good for the new crop beginning June 1954, and an early forecast places the 1954-55 crop figure about 7% above the current season's production.

(*Foreign Crops and Markets.*)

BRAZIL

Oilseed production. Brazil's oilseed production in 1954 may show a slight increase from the low output of 1953, except for some of the forest-produced commodities which have decreased slightly due to higher extraction costs. It is not likely that Brazil will import more fats and oils in 1954, with the possible exception of lard, from non-dollar countries. The outlook is for continued high prices, periods of short supply, and probably a continued decline in exports.

Although oilseed production has recovered somewhat from the 1953 low, caused by drought and declining world demand, output is not keeping abreast of increasing home demand. Domestic prices have been forced up as a result of this demand. High production and processing costs and domestic oil prices above the current world level have caused the loss of much of the export market in vegetable oils and oilseeds.

PARAGUAY

Vegetable oil production. Paraguay's production of vegetable oils from indigenous sources in 1954 is expected to total about 9,800 short tons, or substantially below the 12,300 tons produced in 1953. The indicated reduction in oil output from

last year is the result of expected smaller yields of tung and palm oil.

Approximately 2,400 tons of cottonseed oil will be produced this year, according to trade sources, all of which will be consumed locally.

Tung oil production is forecast at about 2,750 tons for 1954, representing a decrease of 28% from last year. The decrease in this year's crop, which is somewhat below normal, is caused by seasonal variations in the weather, according to trade sources. It is estimated that about 13,600 acres are planted in tung trees in Paraguay.

Production of refined peanut oil in 1954 is forecast at about 450 tons.

Official data regarding exports of vegetable oils in 1953 are not yet available, but trade estimates indicate that about 2,200 tons of tung oil, and 1,100 tons of cottonseed cake were exported last year. According to consular invoices, 761 tons of the tung oil went to the United States. The export of refined edible oils and oilseeds from Paraguay is prohibited by law.

The Government authorised the importation of 1,650 tons of refined sunflower seed oil from Uruguay during 1953, approximately 550 tons of which arrived during the year. It is expected that the remaining 1,100 tons will be imported during 1954. In addition, 1,650 tons of refined cottonseed or sunflower seed oil will probably be imported from Argentina under the terms of the Paraguayan-Argentine Convention of Economic Union.

ISRAEL

Cultivated land increase. The cultivated area in Israel in 1953-54 aggregated 3.65 million dunams, as compared with 3.55 million dunams in 1952-53—an increase of 3%. Although the total cultivated area increased by only 100,000 dunams, there was a 30% increase in the irrigated area—from 600,000 dunams to 800,000 dunams.

Of the total area of 3.65 million dunams, 2.45 million dunams are used for field crops (unirrigated), 260,000 dunams for irrigated fodder, 300,000 dunams for vegetables and potatoes, 475,000 dunams for orchards, 35,000 dunams for fish ponds, and 130,000 dunams for miscellaneous purposes.

The value of agricultural production in 1952-53 aggregated IL.220 million as compared with IL.155 million in 1951-52. However, this increase must be almost entirely attributed to the rise in the prices of agricultural produce. Calculating on the basis of the average price levels obtaining in 1951-52, the value of agricultural produce in 1952-53 reached IL.167 million only—indicating a real increase of 8%—as compared with the 42% increase in monetary value.

Since the establishment of the State of Israel, agricultural production has risen by 84% (based on 1948-49 price levels). Progress has notably been made in the cultivation of potatoes and vegetables, which increased by 145% (1948-49 price levels), field crops (including fodder) 126%, fishing 117%, milk 68%, fruit 64%, eggs 51%, and citrus 44%.

Citrus yields. Citrus groves gave a record yield of 100 crates of fruit per dunam this past season, Mr. A. Hirsch, chairman of the Citrus Marketing Board, announced recently. This does not include the yield of orchards now being worked on abandoned property.

The Citrus Marketing Board is planning to build a central packing station, which will mean a large saving for citrus growers. In the next two years, 50,000 dunams of citrus groves are to be planted in the coastal area, the Sharon, and the Shomron by Mehadrin, Yakhin-Hakal, Rassco, other companies and private companies. Israel exported between 32 million and 35 million worth of citrus last season.

CANADA

Wheat. We have received the following report, on wheat prospects, as on June 8, from the Canadian National Railways:—

Rain delayed spring seeding in many western districts, preventing coarse grains from being completed in southern, and, to a lesser degree, in the central areas of the west. Rain was also blamed for further reduction in wheat acreages in those areas where the season is already two or three weeks later than normal.

Southern and Central Manitoba. Little seeding done due to rain. From 5% to 10% wheat acreage reduction was indicated at a number of points. About 10% of wheat and 25% coarse grains remained to be sown.

Northern Manitoba. Heavy rains held up seeding operations, and wheat might be reduced from 15% to 50% in some districts. Only 15% of intended wheat acreage was sown in the Swan River area.

Southern Saskatchewan. Wheat seeding was nearly completed. Coarse grains varied from 75% down to 50% completed, but it was thought that those could be finished quickly if the weather turned favourable.

Western Saskatchewan. Wheat seeding was practically completed and good progress had been made with coarse grains at most points. Early sown grains were up 2 inches or more.

Northern Saskatchewan. Rain, snow and light frosts at night had been experienced. About 50% wheat and 35% coarse grains had been seeded eastward from Prince Albert. Better progress was made westward from Prince Albert. The season was 10 to 15 days later than normal.

Central Alberta. Some districts reported 75% to 90% wheat planted, others, notably Calgary to Mirror, Cochill to Brazeau, and around Red Deer, reported only one-quarter of the wheat and 10% to 20% of coarse grains had been sown.

Edmonton Territory. Rains and quite low temperature had delayed operations. Good progress had been made with wheat eastward towards the Saskatchewan boundary, although seeding was not general in many other sections.

Peace River Area. Wheat seeding was almost completed and coarse grains 75%. Warm weather was required.

The Okanagan Valley. Weather was cool with heavy rains in this area but no damage to fruit crops occurred. General crop will be one week later than last year.

AUSTRALIA

Wheat. The area sown to wheat for grain in Australia in the 1953-54 season was estimated at 10,691,000 acres, from which an estimated total crop of 199 million bushels was harvested, representing an average yield of 18.6 bushels an acre. The estimated area of 10,691,000 acres is 482,000 acres more than sowings in 1952-53, but 3,189,000 acres less than in the record post-war year 1947-48 when sowings reached 13,880,000 acres. The production estimate of 199,000,000 bushels is 21,100,000 bushels (9.6%) less than the record 1947-48 harvest, but is 3,800,000 bushels (1.9%) more than for 1952-53, and 44,700,000 bushels (30%) more than average production for the five years ended 1938-39.

The estimated average yield of 18.6 bushels an acre is higher than that for any other year, except 1952-53 when the average was 19.1 bushels an acre. It exceeds the average for the five years ended 1938-39 by 6.7 bushels an acre. In Western Australia the area sown was estimated at 2,800,000 acres and production at 40,000,000 bushels, the average yield being 14.3 bushels an acre; in New South Wales, 3,470,000 acres, 65,000,000 bushels, 18.7 bushels; Victoria, 2,400,000 acres, 54,000,000 bushels, 22.5 bushels; South Australia, 1,510,000 acres, 30,000,000 bushels, 19.9 bushels; Queensland, 500,000 acres, 9,800,000 bushels, 19.5 bushels; and Tasmania, 10,000 acres, 200,000 bushels, 20 bushels.

In 1952-53, Australia had 44,473 farms growing 20 acres of wheat, compared with 42,403 in 1951-52.